



## Evaluation of the Danish safety by design in construction framework (SDCF)

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keynote speakers

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## Safety incentives and safety climate in construction



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### **Abstract**

**Background and Objective:** Recent decades have brought large improvements in health and safety conditions to the construction industry, yet the number of fatal and non-fatal injuries in the industry remains high when compared to other industries and occupations. Many employers in construction as well as in other industries have implemented safety incentive programs, such as those that use injury-based safety performance metrics (lagging indicators) to evaluate and reward workers with the goal of improving safety climate; however, these programs often reduce injury reporting and do little in reducing hazards. In contrast and in partnership with individuals from the local construction industry, we developed a leading indicator-based program, B-SAFE (Sparer et al, 2015, *New Solutions*, 25(1):42-58 and [www.northeastern.edu/b-safe](http://www.northeastern.edu/b-safe)). B-SAFE facilitates communication between workers and management regarding hazard controls as identified by safety inspections/assessments (Leading indicators) completed by in-house safety professionals. The program is rooted in frequent (more than once per week) inspections that focus on positive safety communication. The aim of this investigation was to evaluate the efficacy of B-SAFE on safety climate at the worksite.

**Methods:** We conducted a cluster randomized controlled study on four pairs of commercial construction worksites in the greater Boston area with each pair matched for either general contractors (3) or owner (1). Within each pair one worksite was randomly assigned the intervention – running the B-Safe Program whereas the other served as a control site. The program's primary components were: 1) weekly worksite safety assessments that identified all the controls in place as well as the presence of uncontrolled hazards; 2) weekly feedback and communication of these assessments to all the workers via a poster stating the score of each subcontractor and the site and to all the foreman through detailed reports; and 3) monthly recognition and reward when the inspection scores for the whole month achieved a certain predetermined threshold indicating few uncontrolled hazards on site. To assess changes in



safety climate, we invited workers to complete a pre-and post-exposure surveys. The safety climate scale contained nine items that covered the two factors of worker involvement and management commitment (Debobbeleer & Béland, 1991, J. Safety Research, 22(2): 97-103). The evaluation period ranged from 4 to 6 months depending on the site. For the intervention sites the program ran for the duration of the evaluation.

**Results:** The baseline mean safety climate scores for all eight sites were in the high 60's and low 70's (on a 0-90 scale). The mean score of the intervention sites increased by 1.3 points between pre- and post-exposures, compared to the control sites, which decreased by 0.2 points. This 2% effect increased and became statistically significant in mixed effects regression models. Workers, foreman and site management all noted improved team and safety communications across trades on the intervention sites.

**Conclusions.** B-SAFE led to many positive changes, including an improvement in safety climate, awareness, teambuilding, and communication. B-SAFE was a simple intervention intended that engaged workers through effective communication infrastructures and had a significant, positive effect on worksite safety.

**Acknowledgements:** This work was funded in part by the Center for Construction Research and Training (cpwr.com) under its cooperative agreement with the National Institute for Occupational Safety and Health (NIOSH) in the United States.

## Cooperation between experts and decision makers during crisis situations



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*Prof. Wybo research activities concern the management of risky situations, from routine work to crisis situations.*

### **Abstract**

This research aims to study population protection decision-making between scientific experts and decision makers in the case of a nuclear or radiological emergency situation, at the strategic level.

The threat of a major accidental or deliberate event that would lead to hazardous materials emission in the atmosphere is a great cause of concern to societies. This is due to the potential large scale of casualties and damages that could result from the release of radioactive material from nuclear power plants (NPPs), but also explosive, flammable or toxic gases from industrial plants or transport accidents, and chemical, biological, radiological or nuclear (CBRN) terrorist attacks.

Environmental and health impact assessment of accidental or intentional releases of potentially hazardous materials in the atmosphere is increasingly supported by the development of modeling tools. Their potential to assess the spatial and temporal extent and severity of toxic plumes contributes to their growing development as CBRN-E emergency support tools.

In order to respond efficiently to such events, emergency services and authorities resort to appropriate planning and organizational patterns. This presentation focuses on the use of atmospheric dispersion and Impact Assessment modeling (ADIAM) as a support tool for emergency planning and response, to assess the propagation of the hazardous cloud and thereby, support decisions makers in taking adequate counter measures.

There has been a noticeable evolution in the operational use of ADIAM tools over 25 years and especially in emergency situations. This is exemplified using the two most severe nuclear accidents: Chernobyl (1986) and Fukushima (2011).

We argue that the recent developments in ADIAM tools play an increasing role in emergencies and crises management, by supporting stakeholders in anticipating, monitoring and assessing post-event damages, and in the choice of population protection countermeasures.

In this presentation, we focus on how this expertise is used during crisis situations and how ADIAM experts cooperate with decision makers.

Semi-structured interviews have been conducted in 2012–2013 with representatives of the French civilian protection organization taking part in the emergency response. Analysis is based on a conceptual framework that assesses how individuals and group of individuals make sense and react to a situation in difficult conditions.

Results suggest that ADIAM tools are mostly used by scientific experts to assess areas affected by the release and their potential health impact. Using the results provided by those tools, those experts cooperate with decision makers and other stakeholders in order to facilitate understanding of the current situation and its potential development.

Results suggest that the main challenge in further integration of ADIAM cartographic results to support population protection decisions is to take into consideration efforts of the crisis organization to preserve the balance between different stakeholders' expertise. We argue that in this context, ADIAM cartographic results may find their place as a communication support between scientific experts and decision makers contributing to favor a shared situation assessment.

In order to confirm that hypothesis, observations of a series of crisis exercises have been conducted. Those experiments confirm that emergency management is achieved through a collective sensemaking process between ADIAM experts, first responders and decision-makers. These observations also highlight the key role played by the crisis center, regarding its organizational structure as an information-sharing place between people with complementary expertise and experience, supporting decision makers to face all kinds of difficult situations associated to uncertainty and changing circumstances.

Nowadays, strategies to protect population in the early phase of a nuclear crisis consist in three main actions: sheltering, evacuating and iodine pills ingestion. These actions are supposed to be guided by two successive decision-making strategies: triggering reflex actions in pre-planned perimeters in the near field around the accident and when radiation data available, adapting these early actions to the spatial estimation of doses received by the general public all along the situation development.

However, the analysis of our observations during exercises and the Fukushima nuclear accident suggests that between these two population protection decision-making episodes, an additional episode can emerge during which reflex actions have been undertaken but dose calculations are not yet available to guide further decisions.

This intermediate episode is characterized by a high level of uncertainty causing difficulties to decision makers in their communication to the public, so it must be as short as possible; anyway, it is an opportunity for ADIAM experts to support sensemaking of decision makers and other stakeholders, about the situation and its potential development.

In this research, we analyze the three episodes and we argue that in case of a large nuclear accident, technical analysis such as ADIAM tools is essential but not sufficient to take appropriate decisions for protecting population. Decision makers also need other kinds of expertise to adapt their strategy of response to the local context and needs.

## Aviation safety on the ground



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### **Abstract**

The airline industry has a strong tradition in safety, dating back to the 1940's. Ever since, civil aviation has grown tremendously, yet the number of annual airliner crashes was more or less constant until the 1980's, until starting a gradual decline visible until today.

In the last 20 years, Dutch commercial airline companies have not witnessed any airliner accident with fatalities. During the same period, 7 Dutch airline employees lost their lives doing their job on the ground.

Ground jobs comprise ramp handling, baggage and cargo handling, maintenance, catering, and all other kinds of jobs. Ground hazards may also relate to aircrew on the ground during layover in dangerous parts of the world: traffic, crime, terrorism, hotel fire and infectious diseases.

Apparently, the aviation industry is less successful at increasing occupational safety than flight safety. This is in contrast to other industries, such as the oil and gas sector where a positive occupational safety performance may sometimes have lead to a false sense of confidence about the risk of major accidents.

There are several reasons for this difference. In the 1940's, when aviation safety developed, there was not much public attention for personal safety. The safety culture that gradually developed in civil aviation and airlines was generally related to preventing crashes and hull losses, and not to other risks. Although very rare, crashes have enormous consequences, including (most importantly) loss of life, but also direct costs and loss of reputation. Flight safety is thus related to the very core of the aviation industry.

The global aviation industry is subject to an especially strict system of control by national governments and international organisations, such as ICAO. Before they are allowed to fly, airlines must get (and maintain) an Airline Operator Certificate and thus comply with intense regulations and control. The aviation authorities require high flight safety standards. Health & safety, however, is covered by national H&S authorities with less strict legislative and control systems; aviation is not considered a high risk industry requiring special attention.

An underlying cause is general risk perception. Research on risk perception has shown that, in general, risks that attract a lot of media attention, have catastrophic consequences, and are



uncontrollable to a person will be perceived as very severe. Aviophobia, or fear of flying, is a legitimate and common disorder.

General occupational safety risks on the other hand, (such as driving on the ramp or working with ground handling equipment) check none of these boxes. They are perceived as controllable and non-catastrophic, and do not generally receive media attention. They are perceived as less severe, even when the actual risk is higher.

In recent decades, airlines have become aware of this inconsistency in handling low probability-high-consequences, versus high probability-low consequences risks. Integrated safety management for all risks has become the standard. This process has been accelerated by mandatory implementation of safety management systems for flight safety prescribed by national and international authorities, a methodology already common in health and safety (e.g. OHSAS 18000).

The common concept of safety management systems has helped to improve the effectiveness and efficiency of integrated safety management within the aviation industry. Diagnostic tools, such as barrier-based safety monitoring, play an important role. Safety culture diagnostics are common. The challenge for the future lies with using safety science not only to diagnose and explain, but also to improve (occupational) safety.

## The burden of work injury – why so few care



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*As Director of LMRIS he expanded the staff to over 20 terminally qualified researchers, quadrupled the number of the laboratories and oversaw the publication of more than 400 papers in the peer reviewed literature. His contributions were recognized by the International Ergonomics Association, (President's Award), the Finish Institute of Occupational Health, (Jorma Rantanen Award), the Institute of Ergonomics (Otto Edholm Award) and the Institute of Industrial Engineers (MM Ayoub Award). He is a fellow of the IEA, the IEHS and the HFES.*

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### **Abstract**

In countries around the world, the national statistics used to establish the significance of work injuries, are often gross underestimates in both developing and developed economies. Statistics from several countries will illustrate the significance of these data underestimates - especially when compared with more realistic numbers such as the estimates of Takala et al. Through various mechanisms, such erroneous data obscure the significance of work injury which, in turn leads to a lack of attention and subsequently, a lack of resources to address this issue leading to a further paucity of resources with inevitable results.

As an initial step in recognizing and addressing the burden of work injuries, this paper attempts, to elucidate some of the principal barriers, both administrative and technical, to the collection and utilization of data.

Currently, the Global Burden of Disease report, (GBD), and the continuing work on this project appear to be recognized as a premier source of information to address the burden of injury and disease. While there is a significant body of published criticism of the methodology of the GBD three aspects are of particular significance to work injury.

First, the derivation and the relevance of Disability Weights appear to have a distinctly "developed economy" basis which may not be representative of the work (and thus life) demands in developing countries. For example, both lower back pain and traumatic amputation can remove a worker entirely from many occupations in developing economies, a catastrophic outcome which, in more developed countries, might be addressed by workplace accommodations and worker insurance

Secondly, an issue apparently not addressed elsewhere is the monetarization of disability adjusted life years (DALYs) used in assessing priorities and interventions. The vastly different levels of variability between the actual financial costs and the notional costs identified, for example by Dembe (2001). This latter approach, while being socially significant, can hinder interventions to improve workplace safety. The process by which workplaces are improved is

significantly different from other public health issues such as clean water and highway safety. In these latter, the interventions are usually implemented through public expenditures. However, in the case of work injury, interventions are an expense to the workplace owner and data, clearly many times higher than the economic activity of a single owner, are unlikely to generate workplace improvements, barring close enforcement. This latter is significantly absent in many developing countries.

Thirdly, although the GBD project increasingly recognizes the significance of injury, it fails to recognize the significance of work injury within the broader category. In a one year survey of a developing economy we studied a community of 10,000 inhabitants and with 99%+ response rate we identified the majority of **all** injuries were work related. .

Of course there are many other reports seeking to address the significance of work injury but in the same study we obtained work injury rates up to one order higher than previous – well regarded – studies. This discrepancy lead us to attempt to identify the major technical challenges to obtaining data sufficient to validly evaluate the burden of work injuries and inform intervention strategies.

Administrative reporting is challenging, particularly in the formal sources used in capturing the data which may capture as little as 55% of P or Q injuries. In an intervention we introduced, the installation of first aid boxes, with associated reporting demands, identified a further 26% injuries. The transient nature of some workplaces and jobs is a common cause of under-reporting formally, in both developed and developing countries. There may also be conflicting reporting agencies within a national reporting system - and significant discrepancies, of even work fatalities, can occur and has been established in the United States and may be expected elsewhere.

Beyond these issues lie technical problems where the definition of work, of injury and of occupation result in significant differences in the assessed burden and obscuring the significance of work injury. This latter proved to be very significant, especially in the context of workers working more than one job (either in the same period or in other periods) such as those resulting from the annual agricultural cycle. The consideration of second jobs revealed, possibly for the first time, interactions, as measured by increased injury metrics, between jobs.

The imperative for addressing such latter issues arises from a consideration of the utilization of epidemiological approaches in the distinct areas of work injury. Traditionally, epidemiology has been used to identify, often very subtle, relationships between the environment and disease. However in travels to over forty countries the work injury risks are often not at all subtle. What we need is accurate data to establish the burden, individual, economic and social, and to generate the will for improvement by generating outrage at this scourge and the economic resources to alleviate it.

## Care traffic control – high reliability in healthcare



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*His expertise areas are accident and injury analysis, models and systems for injury prevention, strategic and corporate systems for OHS, occupational risk assessment, and the implementation of worksite change. He is a member of the editorial board of 'Safety Science' (Elsevier); he is the Editor of 'IPSO Factum' since 1985, and the 'Safety Science Monitor' (<http://ssmon.chb.kth.se>) since 1996.*

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### **Abstract**

The analysis of risk in human undertakings cannot be reduced to average responses to survey items on “safety culture”, or the quantitative measure of the likelihood of component failure.

The safety scientist should approach risk with a multi-dimensional perspective; many different aspects of organisation and behaviour will explain how and why latent hazards and dynamic processes result in accidental injury.

Examples from process industries, aviation, fisheries, railways, firefighting, and healthcare will highlight the anthropological perspective on safety.

The application of transport industries logistics to distributed healthcare services is suggested as a transfer of systems and logistics solutions from one successful industry to the pre-industrial area of medical and social services.

## Safety culture - moving ahead: on the way to establish a prevention culture



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### Abstract

The necessity for functioning safety systems within companies as a prerequisite for economic success of an enterprise is mostly accepted in the world of work. Avoiding accidents, occupational diseases and work related health hazards in order not to endanger the safety and health of the workforce follows the same but more integral approach. The preservation, promotion and improvement of the health in order to keep the employees fit and able to work safely and in a healthy manner is a newer but nevertheless urgent topic on the agenda. Up to now tackling safety and health with an inclusive approach in order to establish a prevention culture is mostly implemented by larger companies and, predominantly, in advanced economies. The policies, concepts and measures in the area of safety and health preservation and promotion are nowadays not only limited to the workplace but often extended to including the "private life" sphere of the working people as well. But there is still a lack of acceptance detectable in many enterprises and organizations and in the society as a whole. Additionally proven and successfully implemented concepts for integrating safety and health are not very common on a broad basis - especially not within medium sized and smaller enterprises.

In order to contribute to the improvement of this situation – to foster the success of safety and health measures, especially against the background of a growing lack of skilled personnel and experts and also the demographic situation in many industrial and transition countries e.g. Germany, Japan, Korea – a culture of prevention has to be developed and established: Within the enterprises and organizations and also within the whole (economic) societies. This establishment of a prevention culture can ideally be promoted and supported via prevention campaigns, addressed to the world of work and the society as a whole.

The presentation will provide information about the general approach and the major elements of a new DGUV prevention campaign targeting on "Prevention Culture", which is under preparation and will be launched by DGUV and its member BGs and UKs in 2017.

Abstracts

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# Great safety leadership: the only way to a zero injury culture

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**Keywords:** Safety Leadership; Culture; Zero Injury

## Abstract

In today's world getting to a recordable rate of 1 injury per 200,000 hours worked or .5% is no longer good enough. Most organizations have set their sights higher and believe that zero is the only acceptable goal. And it is the right goal! The question is: Can organizations realistically attain this objective within the current business landscape? Recent fluctuations across industries have contributed to a world that is infinitely more complex and varied than in the past. Companies are demanding more out of workers than ever before, and with less supervision. Downsizing, mergers, buyouts, and closings have led to an unstable and uncertain work environment. Pressure to cut administrative and labor costs are leading companies to increasingly rely on third party contractors. The workforce is aging, presenting new challenges to engagement and personnel management. Getting to zero in this environment sounds daunting—and these are only the major issues. While safety procedures have multiplied in most organizations—sometimes with the express intent of getting to zero itself—they have proven ineffective, straining an already overtaxed workforce. Adding more programs is not the solution. Organizations don't need more things to do but a way to get more out of what they are already doing. Research shows that organizational culture and leadership have the strongest impact on safety performance and overall production. Organizations that have high-functioning cultures have proven to produce better results and to sustain them over time. Leadership is inextricably linked to culture, developing and shaping it with everything the leaders says, does, and believes. Keeping employees safe must be a value held in common by the culture of the organization. This culture, or "the way things are done around here," is largely determined by leaders and inherited or received by workers. A study of 94 organizations across eight industries and 18 countries shows a direct correlation between culture and occupational injury rates. Organizations with higher functioning culture experience fewer injuries. This presentation focuses on the type of leadership research indicates is most supportive of a zero-injury culture. What are the best leadership practices that help build confident and efficient work teams? How do leaders develop a management style that gets the most out of employees and achieves the organization's goals in safety and production? What are the practical, everyday ways a leader can directly develop a zero injury culture? We address all this questions and more. Leaders influence their organization's culture every time they make a decision, leave an issue hanging, take a stand, or address an issue. A strategic approach to culture change and safety improvement frames the way forward, providing leaders with concrete actions they can do every day to drive the organization to zero. This presentation shows leaders and safety professionals:

- How to leverage culture to improve safety performance;
- The concrete aspects of culture that actually predict performance improvement;
- How to enhance leadership techniques in a way that strengthens culture and safety climate;
- How to be more supportive of safety efforts in a way that is highly predictive of success; and
- The type of leadership research indicates is most supportive of a zero-injury culture.

# Fatality prevention: rethinking traditional approaches to high-severity and fatal events

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**Keywords:** SIF; Culture; Leadership

## Abstract

The relative infrequency of fatalities and other serious events can give them the appearance of being random and beyond any reasonable degree of anticipation or prevention. In fact, the vast majority of these events result from exposures that are identifiable, measurable, and manageable. The lesson of prominent incidents such as the Space Shuttle Columbia, Oxy's Piper Alpha explosion, the Esso Longford gas explosion, the BP Deepwater Horizon spill, as well as lessons from single-fatality events, is that alongside the proximate causes of each incident, there also co-existed an underlying fabric of systems, mechanisms, and culture that allowed risk to persist. What is needed is a way to address safety across the entire organization with a specific focus on severe-risk exposures. The difficulty is traditional injury prevention paradigms are not sufficient for tackling the precursors that lead to fatal and serious events. We discuss a new paradigm for serious injury and fatality prevention that fundamentally re-orientes the traditional view of accident causality, giving us a more nuanced understanding of the causes of life-altering accidents. Far more than just offering insight into causation, this groundbreaking approach highlights key steps leaders can take to develop a higher degree of dexterity in their injury prevention systems. The way in which exposure data is collected, assessed, and used must accommodate variances in severity potential. Specifically, organizations need to be able to detect "high-potential" exposures (i.e., those with a high potential for leading to a serious injury or fatality) and develop a "systems view" of how these exposures are created. Because serious events occur as a result of exposures that have high potential, what we really want to measure is the rate of precursor events or potential fatal injuries. This measurement includes both the exposures that resulted in an actual serious event plus those that could have but did not. By reducing the rate of potential serious injuries and fatalities, we also reduce the opportunity for serious events to occur. At every level of an organization the factors that contribute to a major incident or serious injury can be influenced by senior leaders. With the concerted effort of leaders, an organizational culture can be developed that focuses on building strong safety practices at all levels. Creating an organization that eliminates serious injuries and catastrophic events cannot be delegated—it requires the involvement of the entire organization from the CEO to the individual worker. This presentation provides a starting point for any leader who wants to redefine serious-event prevention in their organization. Beginning with a review of the latest research, the presenter outlines recommendations for enhancing serious and fatal injury prevention efforts. We examine the reasons behind the apparent dichotomy between declining low-severity injury incidents and the rising frequency of serious events, introduce the concept of precursor events, and present a new framework for leading an organization to be free of serious and fatal events. This presentation covers: • Why the "safety triangle" concept is flawed; • What role data plays in existing paradigms and how to use data effectively; • What precursor events are and why they matter; • How to use the organizational safety mechanism as a tool to refine safety focus; • The role of culture, leadership, and systems in preventing serious events; and • Recommendations for developing effective interventions.

# Certification of ohs professionals through an accredited competency assessment model

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**Keywords:** certification; standards; competency assessment

## Abstract

Both the Board of Certified Safety Professionals and the Board of Canadian Registered Safety Professionals have well-established and ISO accredited models of certification for occupational health and safety professionals. The Board of Certified Safety Professionals, established in 1969, and the Board of Canadian Registered Safety Professionals, established in 1976, have developed comprehensive certification schemes that are highly valued by OHS professionals and employers. Using the Board of Certified Safety Professionals and the Board of Canadian Registered Safety Professionals certification schemes as well as their years of collective expertise in delivering competency assessments, this thematic session will explore the following concepts: 1) The value of certification of the occupational health and safety professional 2) Certification of Occupational Health and Safety Professionals through a Competency Assessment Model This includes The role delineation process, certification scheme structures, and the validity and reliability of competency-based examination models 3) The accreditation (ISO/IEC 17024) process and continuous improvement 4) How certification standards impact industry practices and occupational health and safety education 5) How certification standards promote lifelong learning of the occupational health and safety professional 6) The transportability of the OHS professional and international influence of certification on the OHS profession. The presentation attendees will gain a new appreciation for the value of accredited certification models and how they are applied and their value within the North American context. Attendees will learn how examinations are peer developed from start to finish, and how occupational health and safety professionals are working together globally to ensure the highest quality of certification. Particular attention will be paid to the validation survey process and how this research supports the certification process. The presentation will explore the use of competency-based examination models and the importance of validity and reliability measures within the context of certification, and how the psychometric analysis of examinations are useful to certification organizations. Both the Board of Certified Safety Professionals and the Board of Canadian Registered Safety Professionals are accredited to the ISO/IEC 17024 standard through ANSI and SCC respectively. The ISO/IEC 17024 accreditation process will be explained. Evidence will be presented on how accreditation to this international standard helps drive the continuous improvement of the certification schemes. Examples of how changes to the ISO/IEC 17024 standard have influenced change within the certification scheme will be shared. The presenters will share their experiences on how certification schemes may influence the practice of safety and health, as well as curricula of occupational health and safety educational programs. We will assist the understanding of how certification drives the lifelong learning of the occupational health and safety professional through required re-certification efforts. Finally, the presentation will discuss how a model of certification can help support the global transportability of occupational health and safety professionals and how the Board of Canadian Registered Safety Professionals and the Board of Certified Safety Professionals are contributing internationally to the advancement of the occupational health and safety profession. The method of presentation will be lecture style, with supporting PowerPoint slides. There will be up to four presenters; Directors of the respective Boards and the Executive Director/CEO of each organisation. The presentation will leave time for questions and answers.

# Occupational disease of the unemployed

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**Keywords:** unemployment; occupational disease; asbestos; pleural plaques

## Abstract

Introduction. Unemployment is a huge problem also in Slovenia. Mean rate of registered unemployment in Slovenia was 13.2% at the end of 2014, in Zasavje, an ex-mining region, 16.2%. The Employment agency in its active employment policy invites occupational health specialists to advise the social workers in the process of placement service on the health problems of the unemployed persons to find them an appropriate job. The treatment includes the discourse and overview of the medical record, without a medical exam. At this point the physician's role toward the unemployed client officially stops, but it should actually start according to the Hippocratic Oath. The unemployed persons are often on the border of the health-care system because of unpaid full health insurance or other social reasons. They are also outside the range of established organisations responsible for safety and health at work and are not members of trade unions. Their previous work with all possible damage to their health is not being pursued. There are no lists or registers of their occupational diseases. They are left outside the system. Safety approaches and strategies should be and mostly are designed to meet the current needs, but without compromising the ability of future generations to meet their own needs and definitely without an impact on previous generations. Occupational diseases due to the exposure at previous work place are not systematically explored and verified. EU resolution, dated March 14th 2013, on risks due to the asbestos exposure, emphasises among others the role of medical staff in recognizing professional origin of diseases due to the asbestos exposure, especially due to a very long period of latency. According to this resolution the burden of proof should not be on the patient. Asbestos fibres, after they have been inhaled, cause fibrotic and carcinogenic effects in human body. All types of asbestos are classed as carcinogens by WHO's International Program on Chemical Safety, and an IARC working group of 27 scientists who met in 2009 came to the "fundamental conclusion" in The Lancet Oncology that "all forms of asbestos are 'carcinogenic to humans'", classified in group I. Occupational diseases that can result from occupational asbestos exposure are asbestosis, pleural disease, pulmonary cancer, malignant mesothelioma of the pleura and peritoneum and cancer of other locations. The legislation on the asbestos in Slovenia prescribes rightful claimants, types of asbestos together with its products and the diseases that can result from asbestos exposure. The verification of occupational diseases due to asbestos is also legally required and introduced by guidelines. The patients with one of the diseases due to the asbestos exposure have to start the process of proving the occupational origin of their disease by themselves. The procedure is led by an occupational health specialist. When the proofs from the work place like risk assessment and measurements of the asbestos fibres are collected, the expertise is introduced to an interdisciplinary committee and in the case of being verified as occupational, the patient has a right to claim the compensation. Case report. The case of verifying the occupational disease of the unemployed carpenter who was exposed to asbestos in teen-age period as an apprentice is described. An occupational health specialist working as an employment agency counsellor presented the rights about proving the professional origin of his pleural disease to the unemployed carpenter and proposed him to make an expertise. Extensive pleural plaques were found accidentally by X-ray. The radiologist suspected those plaques to be due to the asbestos exposure. The diagnosis of the bilateral pleural disease was sealed by X-ray p.c. and HR-CT. Accurate work place history was taken by an occupational health specialist and it was found that the unemployed carpenter was exposed to asbestos during 3 years of dual- schooling to become a carpenter and in the first year of his employment, which represents more than 40 years of latency. Instead of working with wood he was working with cement-asbestos plates, which were used as an inside or outside coating. The plates were cut, sawed, screwed without proper masks, ventilation and other safety measures. After those 4 years /exposure time/he has not been exposed to asbestos. There were no paper evidence, no contracts, no environmental measurements, no risk assessment concerning these working conditions involving asbestos. The only possibility to find a proof was to go into the building the carpenter described, which was coated with asbestos plates inside, to take some samples of the plates and do mineral analysis of the plates. Mineral analysis was done by an

electronic line-microscopy and dispersion spectroscopy. White asbestos-chrysotile was found in all samples. Conclusions. The unemployed persons are not included in the system of safety and health at work. Their previous work places and possible damage to their health is still obscure and at the mercy of occupational health professionals. No systematic approach has been developed. In proving the occupational origin of the asbestos disease we found the cause-connection between the exposure to asbestos at the past work place and reactivity of the worker by accurate work-place history together with mineral analysis of the plates in the past working environment which showed chrysotile in all samples. This approach has been recognised as original among Slovenian occupational health professionals. An interdisciplinary committee recognised all the proofs as adequate and verified the occupational disease due to the asbestos exposure of the unemployed carpenter. The case report described above could facilitate changes in minds of those who make decisions.

# Developing a conceptual framework for anticipating and mitigating risks of injury and illnesses in Brazilian and Canadian pork industries

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**Keywords:** OHS procedures; Risk management; Occupational accidents; Pork Industry

## Abstract

Occupational health and safety exposures and incidents have been studied in several sectors and contexts in order to identify multiple types of risk and interventions that could minimize the impacts of work on the health of workers and on the operation of workplaces. The pork industry is growing globally due the high demand from customers while the production has become more concentrated into larger and more intensive operations. Likewise, one of the strategies used by companies around the world has been migrating from developed countries to developing countries in order to minimize general costs such as labor, logistics and installations. In fact, developing countries present lower operating costs, availability of feed, land, water, as well as less restrictive environmental policies. (KUNZ et al, 2008). Donham (2010) observed that the pork industry has been transitioning from family farmers to big corporations due to the intense demand of customers. Hurley et al (2000) identified multiple occupational health exposures and a relatively high level of risk throughout the sector including increased exposure to dust, harmful gases and animals. Knowing that the pork industry has complex and dynamic operations, correlating high scale production and high potential to generate risks to health and safety, it was possible to evaluate that there is a lack of information about ways to manage the risks that influence the health of workers and the flow of the pork production despite the fact that increased corporate management has intensified the need to determine the variables that, directly or indirectly, may result in occupational accidents and trauma to workers and interfere with the performance and the quality of performed activities. Therefore, this paper seeks to address this gap in the literature by providing a framework that can be used for systematic analysis of risk in the sector in order to predict situations that can result in accidents, hazards and potential traumas to people in all steps of the production (from breeding to slaughtering). Methodologically, the research draws on insights from conceptual models that have been developed and applied to identifying and investigating sources of risk in other industrial sectors: the models created by Lipscomb et al (2006), Embrey (1992) and Windle et al (2008) to help identify the potential indirect and direct occupational hazards and risks which impact on the security of work, and the model elaborated by Attwood et al (2006) and applied to the oil and gas industry with a focus on how to define occupational hazards in specific environments or layers and how to understand the relationship between them as well. The model proposed by Attwood et al (2006) was adapted with input from the other models to create a conceptual approach that can be used to predict accident frequency through examination of potential factors that can generate risk in different segments of the industrial (as opposed to family-operated) pork industry. Knowing that the pork industry can take different forms in different countries and present different characteristics in the same country as well, this paper developed a framework through a review of the literature that incorporates elements of diverse characteristics of pork industries located in Brazil and Canada in order to identify the main and potential parameters that might affect occupational health and safety standards, the corporate safety culture and the management process of organizations between the two countries. As a result, the model proposed represents an allocation of all variables on layers in order to understand the integrated relationship of all production parameters and the identification of potential risks in all operational tasks performed by workers at their workplaces in the pork industry.



# Studying the effects of occupational health and safety interventions

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**Keywords:** intervention effectiveness; effects of interventions; evaluation; prevention culture; health literacy

## Abstract

With the growing importance of the service sector and the increasing flexibilization of work, the demands on occupational health and safety structures are becoming increasingly heterogeneous. At the same time, demographic developments and the increase in psychological stress are providing new challenges for the limited resources of occupational health and safety systems, raising the question of how to best use these resources. The representative survey of the Joint German Occupational Safety and Health Strategy (Gemeinsame Deutsche Arbeitsschutzstrategie – GDA) from 2011 shows how urgent this issue is. The risk assessment required by law is carried out by only half of the businesses surveyed. Both smaller and larger businesses focus in their risk assessment on equipment and materials, workplace design and the workplace environment. Aspects of the organization of work such as flexible working hours, social relationships at work and the possible stress due to workloads, deadlines or dealing with difficult individuals and groups are reflected only marginally in risk assessments, if at all. At the same time, the processual nature of risk management is insufficiently anchored both in small and large businesses; often the continuing steps in the process of risk management (determining points for improvement, taking action and verifying effectivity) are forgotten after the risk assessment. The data also provides evidence that existing laws and ordinances are insufficiently compatible with day-to-day workplace realities. In the current discourse the structures of occupational safety and health promotion meet in what is commonly called ‘health literacy’ and ‘prevention culture’. These concepts open the door for a great variety of opportunities for developing prevention programs that meet the needs of dynamic workplaces and are sustainable in an increasingly flexible labor market. With these developments in mind, we would like to discuss in our paper first, how a study of the effects of interventions in occupational health and safety and workplace health promotion might be structured. From a general perspective, the idea of an ‘intervention’ is a planned change in a system from the outside with the intent to adjust that system in a specific, previously defined way. In a systematic review of the literature commissioned by the Federal Institute for Occupational Safety and Health (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin – BAuA) reviews and meta-analyses of intervention studies on occupational safety and workplace health promotion since 2005 were examined. A large number of factors were found that all have an impact on the effectiveness of such interventions. Many parallels between the predictors and moderators in occupational safety and workplace health promotion could be identified. However, the functional factors were found to be inadequately studied both systematically and across interventions. In studies of interventions, the conceptual framework is often not sufficiently explicit, both in terms of the design of the intervention as well as its implementation process. Thus the question of how and under what conditions these factors interact is left for the most part unanswered. To answer this question adequately, it is important to consider the individual operational dynamics above and beyond the intended effects of the explicit intervention being implemented and studied. This puts the focus on the operational context in which an expected result is to be realized, that is, on the context that either advances or hinders an intervention. A good deal of research in terms of the internal perspective of such businesses and the interaction between inside and outside, between individual operational dynamics and the overarching occupational safety and health systems remains to be done. This is why the second part of the paper will focus on empirical

and theoretical approaches to operational dynamics. Using examples from current research projects of the Federal Institute for Occupational Safety and Health, it will be described how this theoretical framework may be useful for developing answers to the question of the interaction of the described functional factors.

# Quantifying and reducing occupational risks in the Dutch cardboard manufacturing trade

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**Keywords:** qualitative risk assessment; safety management; practice; accidents

## Abstract

A methodology and associated tools for supporting decisions relevant to the management of occupational risk have been developed in the ORCA (occupational risk calculator) project, performed on behalf of the Dutch Ministry of Social Affairs and Employment. As part of the ORCA project, a list of 63 generic hazards related to various aspects of workers' activities has been identified, and the risk to workers in the Dutch population from each of these hazards has been quantified. The quantification of the risk is based on 1) the number of serious accidents, and 2) exposure of the working population to the corresponding hazard. The number of serious accidents has been assessed from the analysis of the database of the Dutch Labour Inspectorate, to which work-related serious accidents are reported under Dutch law. A survey of the Dutch working population has provided the total time the working population has spent working in activities involving each of the 63 hazards and the quality of the working conditions that affect the risk. One of the tools developed in the project is the ORCA model. Based on company specific data, ORCA calculates the risk of one or more employees of a company, expressed in three types of consequences (recoverable injury, permanent injury and fatality). This can be compared with the average risk of people in the Netherlands working in similar situations. It is also possible to zoom in on specific activities of an employee, clarifying the greatest risks. In the final step, the user can select from a number of measures that can reduce the risk. ORCA calculates different combinations of measures and costs and presents them to the user. ORCA was introduced in the paper industry during a discussion of the Dutch Labour Inspectorate with the paper industry association, trade union and safety managers of companies. The reason to do this was the large number of serious accidents within this industry. Almost 50% of the accidents that lead to permanent injury (amputations) or hospitalization in the paper industry are the result of tail threading. Tail threading is the manual guiding of paper or cardboard back into the machine after a break. It is performed without shutting down the process as the machine cannot be stopped for economical and technical reasons. Tail threading is work under time pressure and usually at difficult positions. ORCA was used to calculate the risk for the employees of a cardboard manufacturing company, that uses a 60 year old paper machine of 150 meters in length. Manual tail threading takes place after maintenance (every two weeks) and after breaks (sometimes once a week, but sometimes also 3 times a day). After determining the exposure to the moving parts of the machine the risk was calculated for the different process steps. This risk was compared to other similar activities in other Dutch companies. The calculated risk for tail threading was a factor of 14-28 larger than other similar activities with machines in the Netherlands. In the next step two possible measures were identified to reduce the probability of being caught between the rollers during the manual guiding of cardboard in the machine. The measures involved expensive automation which prevents workers to manual tail threading and a cheaper measure, which would not prevent the manual guiding, but prevents limbs being pulled into the machine. The calculation showed that the expensive measure results in the highest risk reduction, but the cheaper measure is more cost effective, as it results in almost the same risk reduction against much lower costs. As a result, the company decided to apply the cheaper measure in the paper machine. Moreover, the paper industry association and trade union accepted this measure as a generally applicable solution. It is included in the sector occupational health and safety catalogue, a document formulated by social partners that describes the measures that have to be implemented to meet the requirements of the Dutch law. The paper will discuss the use of ORCA in calculating the risks involved and show the results. It will also point out some other improvements of the working conditions that were identified during the determination of the risks.

# Safety conscious work environment: antecedents and safety outcomes

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**Keywords:** safety climate; participative decision making; commitment; safety conscious work environment

## Abstract

A safety conscious work environment (SCWE) allows high reliability organizations (HROs) (e. g., chemical plants, aircraft companies or nuclear power plants) to be proactive on safety and prevent accidents of catastrophic consequences (human, economical and environmental). A SCWE is typical of organizations where employees feel free to raise any concerns to their managers, allowing these to have a real picture of the organizational state of operations and identify “weak” or “early warning signs” of safety degradation. To date, research on SCWE precursors is scarce and has practical implications that are relevant for HRO safety. This study examines the influence of participative decision making and safety climate on SCWE, and the mediating role of organizational commitment. Based on the social exchange norm of reciprocity, participative decision making and safety climate may elicit employees’ feeling obliged to reciprocate by means of supporting a SCWE (Blau, 1964). Additionally, organizational commitment would mediate these relationships. Several theoretical frameworks (i. e., the job characteristics model, the theory of work adjustment, and the psychological contract theory) illustrate the influence of work environment on work attitudes. Safety climate and participative decision making features high quality work environments, and satisfies employees need for safety at work and increased opportunities to exercise control and voice their concerns. Subsequently, they would increase organizational commitment, which reflects individuals’ emotional attachment and identification with the organization. In turn, organizational commitment would support a SCWE. This study was based in a sample of 383 employees from a high reliability organization. The response rate was 74.80 %. Structural equation modeling (SEM) was used to test the mediating role of organizational commitment in the positive relationship between safety climate and participative decision making, and safety conscious work environment. Findings support the formulated hypothesis. Results supported the mediating role of organizational commitment. The relationship between participative decision-making and SCWE was partially mediated by organizational commitment, and the association between safety climate and SCWE was fully mediated. This study extends previous research in the field of safety shedding light into the antecedents of a SCWE and contributing to evidence-based safety management. Despite several international organisms have developed guidelines on how to maintain and encourage a SCWE, in the field of social sciences, research on SCWE antecedents is scarce. Moreover, it has relevant practical implications for developing a proactive approach to safety. Findings support the role of safety climate and participative decision making as antecedent of a SCWE. These findings have relevant theoretical implications: they showed the relevance for safety of distant organizational factors such as participative decision making, which has relevant theoretical and practical implications for research on job design and safety. Organizational commitment, which has been rarely addressed in the field of safety, turned to mediate these relationships. These findings encourage further research into the distal antecedents of safety (e.g., work characteristics) and potential intervening variables (e.g., psychological ownership), and its relationship with safety climate. For instance, participative decision making, by means of increased control over work, may enhance psychological ownership and in turn support a SCWE.

# How quantitative are “semi-quantitative” risk assessment methods?

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**Keywords:** hazard analysis; quantitative risk assessment; qualitative risk assessment; semi-quantitative risk assessment; risk matrix

## Abstract

This is a discussion paper intended to promote debate on the way risk assessment methods are currently being classified in the safety literature. Risk Assessment (RA) theory and practice underwent fast development immediately after World War II, as their application became widely spread in the civilian industry. RA tools of the 1950s and 1960s have been classified (and referred to) within two main categories, depending on their approach to assess risk: qualitative and quantitative; the latter is also commonly referred to in the literature by the acronyms QRA (Quantitative Risk Assessment) or PRA (Probabilistic Risk Assessment). This two-way classification was a rather “black and white” vision on how to analyse and assess risks. A distinctive feature between the two categories, is that in most cases, qualitative techniques present the results of the analysis in a tabulated form, i.e., there is a “table of results”, organised in a systematic and structured way, whereas quantitative techniques, namely the pioneering Fault Tree Analysis (FTA) and the Event Tree Analysis (ETA), incorporate a specific diagram to show logic relationships, i.e., they establish logic graphical representations to support the subsequent probabilistic calculations. Such graphical representation inherent to each technique, may sometimes be used as a stand-alone feature, to explain various cause-effect relationships; the graphs may also be used to help visualising a range of possible outcomes (different accident scenarios), even in situations where the probabilistic assessment was not actually carried out. In other words, despite FTA and ETA being developed as probabilistic tools (therefore being quantitative) the diagram feature can be used “per se” to help the analytical step, even if the quantification step is not performed. Soon enough other tools appeared, adding new features, which unveiled different tones of “grey” emerging from the strictly black and white picture. This was the case, for instance, with the arrival of many forms of Risk Matrices to support the evaluation of risk level, or risk magnitude. A number of these matrices use only nominal (categorical) scales, whilst others assign numerical scores for rating a couple - or even more - evaluation parameters (e.g.: likelihood and seriousness), which are multiplied to give a final score, also numerical, for establishing risk level. The first - using only two dimensions - are called simple matrices whereas the latter are multiple scale matrices. At the same time, the mathematical modelling of risk has also seen new developments aiming at quantifying the risk in other ways beyond the stickily probabilistic fashion. This is the case, for instance, of possibility methods (e.g.: Bayesian and fuzzy logics approaches to RA). As a result, new concepts and new terminology appeared in the literature classifying certain RA methods as “hybrid”, “semi-quantitative”, etc. Such evolution in the RA lexicon, however, is not consistent in terms of meaning and definitions. Just as it happened with other safety concepts in the past, this calls for common understanding and clarification. This now seems to be a good opportunity for promoting a broader discussion on the matter, since the “working on safety” network offers a good forum for this purpose. This paper intends to encourage the debate among safety researchers and specialists, by setting out the question “how quantitative are “semi-quantitative” risk assessment tools?” It also offers a possible answer to the question, by proposing that a fundamental notion behind the concept “quantitative” is that numbers, whenever used, need to have a mathematical or statistical real meaning associated with them. Otherwise, when numbers are assigned only to establish a scale or order (scores), the assessment would better be considered as a qualitative one, in which subjectiveness is still a relevant part of the scale.

# KPI-OSH tool - the project on the selection and use of leading key performance indicators for measuring operational performance of the OSH management system

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**Keywords:** OSH management system; operational performance; leading indicators; key performance indicator (KPI); Analytic Hierarchy Process

## Abstract

**BACKGROUND:** OSH management systems (OSH MSs), which are based on international documents such as OHSAS 18001 or ILO-OSH 2001, or on national specifications, are maintained in hundreds of thousands of enterprises all over the world. However, there is no sound evidence that the systems are sufficiently effective in terms of preventing occurrence of accidents and diseases at work. This state of affairs calls for new approaches to OSH MS performance evaluation; new resilience-based methods are needed, with a particular focus on the measurement and genuine improvement of system operational performance. In light of the above, the international project KPI-OSH Tool was launched in 2014. The project is carried out by the consortium made up of three partner organisations: CIOP-PIB, Finnish Institute of Occupational Health and TECNALIA Research & Development (Spain). **PROJECT AIM AND OBJECTIVES:** The overall aim of the project is to improve effectiveness of OSH MS by the selection and implementation of Key Performance Indicators (KPIs) for measuring operational performance of the system. The project objectives include the development and validation of a relatively small set (ca. 20-30) of KPIs assigned to individual components of OSH MS, and the development of an easy-to-use software tool that will support managers in using KPIs on a daily basis. Monitoring these KPIs should provide managers with the synthetic and concise picture of the system performance, and will allow them to respond more quickly to early warnings of irregularities in the operation of OSH MS detected across all system components. **METHODOLOGY:** It was assumed that KPIs should be assigned to individual OSH MS components (processes) according to a model of OSH MS proposed in a draft standard ISO 45001, which is currently being developed by the ISO Project Committee no. 283. The set of KPIs was developed by selecting the best indicators out of OSH leading (positive) performance indicators (PPIs) currently being used and referred to in the literature. A literature analysis resulted in a collection of 373 candidate PPIs. Next, PPIs derived from the literature have been divided into 23 groups and assigned to respective OSH MS components. This process allowed also for the elimination of redundant PPIs, and ended up with building a set of 120 PPIs. Then, this set was consulted with safety managers in several enterprises in Finland and Poland, which has led to its further reduction down to 65 PPIs in 20 subsets. To support the KPI selection the method of the Analytic Hierarchy Process (AHP) was applied, which involved the determination of various ranks for the criteria to be applied, and subsequently an expert pairwise comparison and evaluation of decision variants in relation to those criteria. In order to choose appropriate criteria for the KPIs a comparative analysis has been conducted with regard to criteria recommended by leading scientists in the field of safety and resilience engineering. As a result of this analysis the prioritisation of PPIs was conducted with regard to the 5 main criteria: Relevant, Comprehended, Cost efficient, Measurable and Objective. The weight of 40% was assigned to the most important Relevant criterion and 15% weights to each of the other four criteria. In parallel, the prioritisation of PPIs was also made by evaluating them in relation to the same criteria, but with equal ranks (20% each). **RESULTS:** The result of this method was the selection of 27 KPIs, where 20 of them are considered basic ones, and 7 serve as alternatives for certain OSH MS components. Subsequently, the concise descriptions for all selected KPIs have been elaborated using a specific one-page template, which included the following sections: 1) KPI acronym; 2) KPI name; 3) Name of OSH MS component (related to a given KPI); 4) Data necessary to calculate the KPI; 5) Calculation formula; 6) Source of data to calculate KPI; 7) Measurement frequency; 8) Graphical representation (diagram form); 9) Colour policy for the diagram; 10) The method of the KPI implementation in the enterprise; 11) KPI contribution to four essential abilities of a resilient system. The mentioned descriptions have been the basis for developing the software tool aimed at supporting managers in using KPIs, for which specifications were proposed by TECNALIA and consulted with other partners. The tool is



easily customisable and user-friendly, and its main functionalities include: 1) selecting preferred KPIs (out of 27 predefined KPIs); 2) modifying KPIs according to OSH MS specific conditions in a given enterprise; 3) creating additional KPIs (if needed) by defining their basic parameters and calculation formulas; 4) collecting data necessary to calculate KPIs for respective reporting periods; 6) generating the reports in MS Word format with diagrams customised by the user that will present the KPIs' values in a transparent, dashboard-like, form. NEXT STEPS: The next phase of the project includes the translation of the software tool and its manual into Polish and Finnish, which will be followed by the pilot implementation of the tool in several enterprises in Poland and Finland. The aim of this phase is to verify the actual usefulness of KPI-based approach, and of selected KPIs as far as their ability to measure and monitor OSH MS operational performance is concerned. Finally, project results will be disseminated by brochures, seminars for interested parties, and articles in scientific journals. MORE INFORMATION: The information on the project and the consortium is available on [www.oshkpiotool.eu](http://www.oshkpiotool.eu).

# Ergonomics analysis at workstations not fixed

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**Keywords:** Ergonomy; Posture; Plastering work

## Abstract

The activities of construction are characterized by intense workload, what is usually related to awkward postures, excessive and repetitive movements, occupational accidents and injuries. This study presents an ergonomic analysis of work aiming on postural ergonomics, through no fixed workstations, to analyze the activity of the construction of indoor and outdoor plastering. And so, find solutions to the possible non-conformities found in this activity. The study was conducted with employees of a plastering company of the city of Murska Sobota, Slovenia. This company works with clay material used for the plastering activity. The different activities of workers were recorded by video and photography, and these records were used in further analysis. Still, an analysis through interviews and questionnaires (diagram of pain, Nordic questionnaire and occupational accidents record) was made. For postural analysis was used to OWAS methodology. By analyzing in a work situation we have to consider ergonomic vision system (man-machine- environment) when one of these factors change, the ergonomic solutions also change in order that, in plastering work, there is a variation of these factors therefore knowledge is the same, but the place will change, that is, we have a variation in the workplace and in their work environment as a whole. This provides a higher possibility of accidents and musculoskeletal injuries due to these variations. After data analysis, non-conformities were found regarding the use of safety equipment, such as non-use of facial protection, awkward postures incidences as bending of the spine, cervical tilt, overload on the upper limbs, especially shoulders and difficulties in ranges in interface employee and workplace. In the analysis OWAS the working posture was classified as level 3 (posture that deserves attention in the short term), already the Nordic questionnaire showed signs of discomfort in the neck, shoulders and backbone. It is evident that inadequate postures when performing the task is the cause of the evidences found, this evidences stems from the dimensions of the workstation, which promotes difficulties for workers in reaches in tasks that presents higher walls, especially where there is a connection between the wall and the ceiling. In relation to the work accident record was found a total of 6 falls considering the 2013-2014 period, two with more severe injuries such as fractures of the ribs and shoulder dislocations, and these related to stairs. Due to the variability of the workstation there is a use of "improvise" by workers using tools and structures in order to perform tasks the best way possible, however, these improvisation do not consider the correct working posture and the risks in work activity. There is a lack of equipment and tools that can reduce the anthropometric differences between the workstation and the worker to eliminating and / or reducing awkward postures and consequently accidents caused by falls. Based on the results, were suggested some solutions commercially available such as adaptive mobile scaffolding and automatic plastering machines. Besides, the solutions suggested for the studied company, it was important to clarify how the best ergonomic practices can improve the workers' activity in wall plastering. For this, was performed a lecture to pass health and safety guidelines, ergonomic practices, issues such as use of safety equipment and the improvement of working posture, in order to present opportunities for improvement. Still, breaks and dynamic stretches were suggested to avoid the consequences of awkward postures as workers discomfort and body aches. The work of the plasterer is a repetitive and slow work, requiring for workers, both psychologically and physically. The plastering activity presents ergonomic challenges when designing and improving the workplace because the workstation are not fixed. This study shows that improving posture and health of workers depends not only on improvements in safety and occupational health or postural ergonomics, but also other factors such as the architecture of the workplace, tools, machines and structures. There are few commercial solutions, what provide opportunities for new products, tools and machines which target the safety work activities in the construction industry, ie, wall plastering.

# Personal constructs concerning safety and atmosphere

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**Keywords:** Personal constructs; Safety research; RGT interview

## Abstract

Personal construct theory (PCT) states that people model the world with personal constructs, which are made up of comparing real-world events and items. Constructs differ from concepts that the constructs are bipolar whereas the concepts are unipolar. This bipolarity of constructs is due to the comparison of events and it means that all constructs have both positive and negative scales. Scales play an important role defining the true meaning of the construct. For example two different persons may same construct "Professional skills". If the individual scales were: "good – poor" and "united style – personal style", the meaning of the construct is different. Actually the assimilated meaning of the construct can be reached only through the personal scales. Personal constructs that have substantial positive impact on safety, may be the most important triggering cognitions for safety action. They are found to be most critical and important concerning safety. We have interviewed 74 persons in 5 different companies in process industry with the repertoire grid technique (RGT). In RGT there are no predetermined questions, but the interviewee reveals those construct and corresponding scales that she finds most important. When the constructs and scales are found out, the interviewee also defines the importance of the construct to the safety and to the atmosphere. The most important advantage of this method compared to questionnaire or traditional interview is that the interviewee reveals not only those construct that she finds most relevant but also the importance of those constructs to safety and atmosphere. This diminishes the interpretation done by the researcher and therefore the results gained by this method become substantially more valid. The 74 interviews generated 708 constructs. The original purpose of the research was to find out what had been the most important changes in the companies. The interviewees also defined the direction and strength of the change. At this point the changes were not restricted to nor were the interviewees advised to safety related issues. All changes were put on record and exact words of the interviewees were used. After all constructs were gathered, the interviewee was asked to define the relevance of the constructs to safety and atmosphere. Negative and positive scales were independently assessed in the numerical scale 0 to 5, where 0 was "no affect" and 5 was "has significant impact". The scales may be asymmetric in the sense that they have different impact on the constructor. For example construct "cleanliness" may have great negative impact on safety if the environment is dirty but ultimate cleanliness only minor impact on supporting safety. Preliminary results show that 59.2% of the positive and 51.0% of the negative scales of the constructs have great impact (4 or 5) on the working atmosphere. The percentage values for safety were 44.6% for positive and 37.7% for negative scales. The researchers classified the constructs and in this report we present those classes that had most significant impact on safety and atmosphere. Only 2% of the constructs, which represent changes in recent years, had no positive effect on atmosphere. We will classify the constructs and analyse which classes had most powerful effect on safety and atmosphere. This classification and results help organisations to concentrate their safety improvement actions to those their employees value most. Since the constructs are truly personal, the variety of constructs that affect safety is surprising.

# Analysis of the teaching activity in a Brazilian public university and its impact on the health-disease and occupational safety

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## Abstract

Introduction: Physical and emotional stress to which professors are subject in their working environment is well known and significant in determining stress-related disorders such as depression, anxiety, phobia and burnout syndrome (Cross et al., 2010). This crisis in the profession increases the cases of absenteeism, burnout, depression and multiple early retirement. The intensity of teaching, the proliferated obligations, the growing number of students in classes and the increasingly inappropriate behavior of some students are some of the causes of the painful character of this profession (Jarty, 2012). The wear related to the practice of the same activity over a lifetime of work, criticism of society to the current educational system, the lack of recognition of work and health problems are among the leading causes of early retirement among professors (Cau-Barielle, 2014). For those who are active, the strain is a dangerous enemy, to the extent that may cause performance failures or accidents (Seligmann-Silva, 1994). Goal: To analyze the conditions and the organization of work of higher education professors at a public university located in southern Brazil, and the requirements of this work and its impact on the health-disease process and occupational safety. The study was in accordance with the method of analysis of the work centered on the activity analysis. It focused on the qualitative approach by data from the observations of the teaching situations supplemented by data from simultaneous and consecutive utterances and semi-structured interviews. Permanent and temporary professors of both genders took part of this research in question and agreed to participate in the study willingly signing the Instrument of Consent. It took place from 2010 to 2013, in a new sector of the public university which was originally a Campus in expansion and later became the headquarters sector located in the capital of the state. Results and discussion: The precarious working conditions, are mainly due to limitations of space and jobs, resulting in overcrowding of offices and presence of frequent noise which affect attention and the implementation of intellectual works; lack of maintenance of computer equipment and difficulties in transport. The actual work goes far beyond the prescribed work, for example, working hours, often extended beyond the contracted hours, compromising the time of extra-professional life. The workload appears to be directly related to the quantity of professors and administrative technicians, but also is associated with the multiple tasks to be undertaken, the intense pace of work (tight deadlines), demands for productivity, frequent interruptions. There are physical requirements, but also important cognitive and psychological demands: "... usually what weighs more is mental issue, psychological stress and mental demand which is necessary to perform the work, for instance I had a week to work in the announcement for the extension project and then decide who would be the student aid". (Interviewed Professor). The current health status of professors is worrying, there are cases of gastrointestinal problems and sleep disorders, but the most remarkable are the mental illnesses such as depression and panic disorder, in addition to the reports of use of antidepressant medications and anxiolytics "I think I'm depressed, it is constant, but we will overcome gradually, you do not have the necessary working conditions. You want to do things and can't". I Take work home, my eating habit is terrible. Most nights are bad nights. I have Saturday and Sunday." Another professor reports that always sees tense, heavy faces: "People were losing their luster, were leaving." He adds that currently there is a large number of professionals taking medication to be able to support the workloads and the environment. Besides the variability of working conditions, subject to rules of the office of a secular institution, but antagonist for they have entered into a sector with an innovative political and pedagogical projects, suffering from a lack of interest and disrespect of many students and resent the lack recognition. These workers, to the extent that their inventiveness and expertise are mobilized, renormatizam its activity. When the work

organization hinders the exercise of these powers, through, for example, intensifying the pace of work, taking the experience of activity as a meaningless, can lead to accidents and new or worsening / disease chronicity (Silva , Brito and Athayde, 2004; Ribeiro and Neves, 2009). Interpersonal conflicts, individualism, unproductive meetings and strained as a result of work organization and the lack of university infrastructure are blooming. Some pleasure is experienced by professors in face-to-face teaching with students, the social status of belonging to a renowned educational institution, autonomy and self-regulation that allows the profession and the job security. Conclusions: Professors urgently need better working conditions and infrastructure for the preservation of themselves health and safety and continuity of quality performance. To know and understand the conditions and the organization of work of these professionals, the requirements imposed and the variability present in the academic life contributes to reflections on actions of improvements and changes in the working world.

# The toolbox training program for Danish construction foremen – aims, content and design of the process evaluation

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**Keywords:** Toolbox meetings; safety training; safety communication; qualitative study; employee involvement

## Abstract

Background Accidents at work and physical attrition continue to be major problems in the Danish construction industry, and provide many challenges in implementing initiatives in prevention and safety culture. Construction project 'Start-up' meetings and 'risk evaluations' are often carried out prior to engaging in projects and tasks, which include a focus on improving safety. However, the daily communication between a foreman and his work crew, colleagues, leaders, customers and other construction professions mainly address production issues and deadlines. 'Toolbox meetings' are a popular tool used in construction in many countries, and a 'Toolbox training' program is currently being developed in Denmark with a focus on improving construction foremen's knowledge and communication skills in regards to present work tasks and their related health and safety risks on site. Involving employees (colleagues, leaders, customers and other construction professions) in the daily planning process is a key element in the project model, and in the Nordic safety culture. The purpose of this paper is to describe the content and aims of the training program, as well as the design and methods of the process evaluation. Content and aims of the training program Unlike 'Toolbox-meetings', which involves a foreman's preparation and delivery of a specific 'Toolbox-talk' with his crew (e.g. safe use of machines, PPE etc.), we developed a 'Toolbox-training' program which focuses on improving foremen's knowledge and skills in safety communication, not only with their crew members, but also with their colleagues, leaders, other professions and customers. The overall goal of the training program is to reduce physical attrition & improve injury/accident prevention, health and safety culture for all parties, while at the same time improving planning and safety communication. More specifically, the hypothesis of this study is that the approach will promote safety communication on a daily basis among the various parties, which again will raise risk awareness and increases the various parties', particularly the work crew members', participation in safety dialogue. Participation is proposed to then increase influence on planning and safety procedures, which improves the prevention of work accidents, health and safety culture on construction sites. A 22½ hour classroom program is carried out over nine weeks, with two weeks on-site training between each of the five classroom training days (4½ hours each day). The training includes topics such as: foreman roles and responsibilities, communication (verbal and non-verbal), conflict management, planning systems, leadership & cooperation, prevention of injury and work related disease, as well as improving health and safety on construction sites. Training consists of a mixture of theoretical lectures, practical casework and role-play, as well as assignments to be carried out during the two weeks between each classroom session. All foremen are actively involved in the process evaluation. Methods The study is based on 30 foremen who have taken the training in three different groups in 2014-2015. The foremen are from five different construction companies covering two geographically (and culturally) different regions in Denmark (Jutland and Sealand), and who work in various construction trades (e.g. earth and concrete, masonry, carpentry, scaffolding, demolition). Process evaluation of the training program serves both a formative and a summative purpose. The formative purpose involves a continuous use of process data and feedback from the participating foremen for



optimizing training through learning. The aim of the summative purpose is to determine whether the training was implemented as intended and to provide guidance for future interventions. According to previous workplace intervention studies the following components are recommended to be included in process evaluations: fidelity (quality), dose-delivered (completeness), dose-received (exposure), satisfaction, reach, recruitment, and context (barriers and facilitators). We summarize the seven elements into four main research questions for the process evaluation: (1) Was the expected target population reached? (reach, recruitment), (2) Was the program implemented as intended? (fidelity, dose-delivered, dose-received), (3) How did the foremen and their work crews experience the training? (satisfaction), and (4) Was the implementation influenced by contextual factors? (context). To conduct this process evaluation we use two data sources: questionnaires for all participating foremen before and after the training and semi-structured interviews with the foremen and their work crew members (and where relevant leaders and colleagues) before, under and after the training. Results The training and data collection are still on-going, however the initial results provide evidence that the training topics are relevant and useful for the foremen in their everyday interaction with their crews, colleagues, leaders, customers and other construction professions. Inclusion of health and safety in their daily planning and communication is seen as giving added value to their work and their projects. However, work crew members are not always included in the planning process, and not all foremen like to ask work crew members for their input and opinions. Potential barriers that hamper the daily safety dialogue are e.g. the belief that crew members are not interested in being involved, and a high turnover among work crews, which affects safety dialogue and knowledge sharing negatively. Discussion This project provides preliminary evidence that 'Toolbox training' can be adapted to the Danish construction safety culture to successfully improve safety dialogue among Danish foremen and other parties. By documenting all aspects of the implementation process, we will be able to assess to what extent the implementation of the training program was successful and under which conditions. A successful implementation is a prerequisite for testing the effect of 'Toolbox training' in the future, as intermediate outcomes and final effects cannot be expected if the implementation fails. This study will continue to investigate which barriers and facilitators hamper and trigger the implementation of 'Toolbox training', and the program will be optimized accordingly.

# Integration of safety in management tasks in onshore transport SME's

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**Keywords:** Transport sector; safety management; intervention; involvement and motivation

## Abstract

In EU the transport sector has an incident rate of accidents at work at 40 pr 1000 employees. The transport sector is characterized by many small enterprises of which 97 % of the enterprises in Denmark have less than 50 employees and 89 % have less than 10 employees. The safety problems for the employees are the activities carried out by loading, unloading or work with transport equipment carried out at many different work places. The main safety problems are falls, heavy lifting, poor ergonomic working conditions, hits or collisions with goods, equipments or falling objects, the traffic risk situations, work with animals and finally the risk of violence and robbery. To create a high level of safety in an enterprise is a difficult task that demands a great degree of management engagement and its constant focus. It is not only a question of having the right equipment, procedures and organization etc.; it is also necessary for everyone in the enterprise to have an understanding of safety and feel obligated to take responsibility for safety in all work at all times. Accident research shows that safety must be integrated in the whole enterprise and function on all levels of management, while it must also involve all employees in their daily work. It is important to emphasize training in safety, good communication, good order and a stable staff of employees. Pro-active accident prevention also involves process, communication and organization, where management plays a significant role, which includes its ability to involve both middle-level management and employees in creating a high level of safety. These findings are mostly derived however from large enterprises. These findings must be seen in relation to the transport sector, which is characterized by many small enterprises especially involved in transport of goods on shore and has a high accident rate. The transport sector is also characterized by the fact that managers have to lead from a distance. The drivers are on their own and very often alone in the truck. The drivers' working conditions are very often out of the managers' hands, because they are determined by the conditions at the place where the goods are picked up from the suppliers and where they are delivered to the customer. The research question is: "How can experiences from large enterprises regarding how to achieve good safety be adapted and applied in small enterprises in a branch such as the transport sector. The aim is to present tools and barriers for SME's on how to integrate safety activities in the daily work fulfilled with other duties and few resources. An action based study for prevention of accidents has been carried out in six SME transport enterprises over a three-year period. The study has been organized together with the employers for following their plan for integrating safety into their basic work. The methods has been an action oriented research model, where the researcher and the enterprises together has developed and make experiences with the use of different tools for accident prevention. The result is 1) A realistic strategy for integration safety, quality and environmental factors in an SME and procedures for how to go from strategy to action. 2) Different tools developed to fulfil the strategy going from risk identification, involvement of the employee and motivational activities. These tools comprise to simplification of safety management methods, but adjusted to a new focus and awareness for managers of small enterprises including documentation of the SME's own internal costs of compensation for all damages and injuries. 3) However, several factors create barriers for the SMEs' efforts even there is a visible economical advantage to obtain. The barriers can be described as a kind of "Maslow's pyramid" for the businesses in the form of Bourdieu's five forms of capital where lack of economical capital, physical capital and human capital do prevent changes from being made. The intervention shows a relevant focus on both the risk for occupational accidents but also the risk of incidents that have consequences for the cars and the deliveries to customers. A calculation of the internal costs of compensation of all damages and injuries shows an amount that covers 20-100 % of the enterprises' profit for a year. A long list of activities towards changes in the enterprises towards better safety and quality in their business has been developed and tested. The intervention in the enterprises is a simplification of safety management methods but adjusted into a new focus and awareness for the managers of small enterprises. What really matters is to teach the managers to manage and focus on both

safety and quality connected with time schedules and costs. Furthermore to support him with tools and methods for how he can motivate his employee for a better safety behavior and to create a proper safety culture in the enterprise. The results will in the end be included in a new strategy for the insurance company and the transport sector's organization towards a better safety performance.

# The importance of managers' participation including interpersonal and group communication in the prevention of near miss accidents in safety management systems

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**Keywords:** prevention; near-miss accidents; behavioral based safety; safety culture

## Abstract

The aim of this project was to address the problem raised by the corporation factory. The problem concerns the relatively small amount of reported near-miss accidents. The project was prepared during a three months internship in the factory where the interpersonal and group communication system was compiled. The system focuses on the factory top management, middle management supervisors as well as employees' involvement in the prevention of near miss accidents. It is commonly known that "prevention is better than cure" so the aim of the research is to build awareness concerning the importance of reporting any inconveniences /disturbances at workplace and then implementation of prepared tools. According to Henrich's accident pyramid, the base of the injury are unsafe acts/conditions and near-miss accidents which often are neglected by workers. The project consists of five chapters. First Chapter is introductory and justifies the subject as well as defines the aim and content of the paper. Second Part analyses the available literature. It consists of six subsections where each of them reports on the terminology used in the paper. Moreover, Second Part standardizes and clarifies the understanding of the definitions that are often misinterpreted. There are shown and compared guidelines of internationally applied British Standard for occupational health and safety management system OHSAS 18001 and equivalent Polish version of the standard which is PN-N 18001. Despite the fact that both of those standards should be constantly developed according to PDCA circle, there are some essential differences in implementation and auditing the systems. Subsequently, next chapter presents findings achieved during the research and confirms the initial hypothesis, which was that the managers' contribution in health and safety systems plays significant role in activation their workers to take care of their health as well as counteract their fear of reporting any inconveniences at their worksites. The paper shows alternative approach to the statistics of work-related accidents. According to MORT methodology, where there is shown that the accidents have not got just one cause but there is a chain of events which lead to accident at workplace. The method precisely examines the source of negligence of the managers. Consequently, it means that there are often a negligence of supervision staff, not just blue-collar workers, as a main reason of unwanted occurrences. The research made in the factory floor also confirmed this approach. The blue-collar workers completed a questionnaire "Why I do not report near miss accidents". The second audit tool was MISHA form (Method for Industrial Safety and Health Activity Assessment). It was conducted not only by the blue-collar workers but also by Health and Safety inspectors and managers of the production line in order to check if their point of view concerning safety culture is the same. The obtained results were significant and established the base of the designed tools to improve the number of reporting near-miss cases as well as unsafe acts and work conditions. The program was based on two conceptions: "4A" (awareness, acceptance, application, assimilation) and "7P" (the approach which enable to develop reporting and examining near-miss accidents). It is connected with behavioral based safety, as the all workers constitute veritable factory resources. It is they, who create the atmosphere and conditions of job environment. The project is divided into four main parts and assumes constant development as the desired behavior of workers not immediately become an permanent part of the system. First step includes tools for so called Safety Moments in the factory (weekly workers meetings with production line supervisor in order to discuss safety issues, some inconveniences occurred in previous week etc.). According to survey results, workers are not aware of near-miss accidents and why is important to report them. They do not want to be called as sneaks by their workmates, and that is why during that meeting there is the presentation which explains the importance of reporting near-miss accidents as well as a concise explanation of differences between near-miss accidents, unsafe behavior/conditions and accidents. The material also

includes some case study exercises. Within the first step there is also a promotional campaign. Second step includes a voluntarily and anonymous reporting system, which, after half of the year of application, transforms into a more motivational way of reporting system which enable to form desired attitude of workers, thanks to appropriate notice of managers and their feedback. This part of the project go beyond the factory and carry safe behavior also into workers' houses. Health and safety issues should not be a taboo subject. The next step is about giving feedback to each reported occurrence. Thanks to that workers do not feel disregarded and know about the decision or proceeding actions that were undertaken. Finally, there are given some communicational advices, for instance, how the managers should react when the blue-collar workers report accidents or what they prefer not to hear from their supervisors. Building safety culture at enterprises requires time. It is a multistage process and depends on the culture of the society, culture of the enterprise as well as culture of each worker. It evolves the level of trust in the enterprise and the information flow. Therefore, it requires time, workers' awareness and constant development. Only by removal of the source factor of the accidents can we minimize the number of major injures. The project also includes five appendices that complement this research project. It is worth saying that the steps of the project were gradually implement in the pilot factory and the project enjoys a good reputation among managers.

# Prevention of road accidents and injuries for the safety of employees - the German experiences

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**Keywords:** Prevention; Road Safety; VisionZero; commuting and work-related road accidents; Safety programmes

## Abstract

The presentation looks particularly at the commuting and work-related road accidents based on general accident figures for Germany collected in recent years. Special emphasis is given to a particularity of the German insurance scheme where accidents on the way to and from work are included in the compulsory insurance scheme. Work-related and commuting accidents in Germany by employees are covered by an insurance protecting them against the consequences of accidents suffered whilst working. The "statutory accident insurance" is funded by contributions from the employers. Road traffic accidents occurring during work and while commuting from and to work are also covered by this insurance. The consequences of accidents of employees sustained in road traffic are generally worse than those of accidents at work as such. Over half of the fatal work-related accidents in 2013 were road traffic accidents - they occurred on the way to and from work (commuting accidents), or on work-related itineraries. This means that more people lose their lives on work-related itineraries than in accidents at work as such. By the way, every fifth pension which is paid for work-related permanent reduced working and earning capacity is caused by a road traffic accident. From these numbers, you may conclude that road traffic accidents for German society, and for the companies, represent an economic challenge in addition to the social impact they always have. DVR has committed itself in 2007 to the Vision Zero road safety strategy. The basic requirement of this vision is: No one must be killed or seriously injured in road accidents! This vision is based on four fundamental principles: Life is not negotiable. No other asset can be important enough to be offset against human life. Humans make mistakes. Since people make mistakes, the environment in which they live - and which includes road traffic as well - needs to be designed in such a way that errors they commit do not have irreversible consequences for their health. The tolerable limits are set by the physical integrity of man. When an impact on a tree at 80 km/h has deadly consequences, there are two options: either speed needs to be reduced, or other measures must be taken to ensure that the impact either does not occur at all, or that the consequences do not threaten the lives of vehicle occupants. People have a right to safe transport systems. The responsibility for road safety must not be shifted to the individual road user. It must be exercised by all people who have an influence in the transport system: Politicians, decision-makers within public authorities, engineers, scientists, employers, and the road users also. Based on this, tasks and role sharing between the German Statutory Accident Insurance as the provider of the compulsory insurance and the German Road Safety Council are highlighted with all activities being based on Vision Zero. As an example of the cooperation between the statutory accident insurance and the German Road Safety Council, the "Safety on all roads" (Sicherheit auf allen Wegen) programme is presented. For over 30 years now, this programme has been aiming at the prevention of work-related road accidents including numerous activities such as training, campaigns and seminars offered for a multitude of target groups. My presentation topics will cover the following aspects: First, I would like to introduce my organization, the German Road Safety Council. Then, we will take a look at the accident situation in Germany. And here, I will also go into details regarding injuries suffered by employees in road traffic, and explain the "Vision Zero" approach which is our basic for road safety. In the main part of the presentation, I will present to you the programme "Safety on all roads" (Sicherheit auf allen Wegen), which our partners and ourselves have been implementing for over 30 years. To conclude, I would like to mention some ideas brought forward on the effectiveness of work-related road safety and the factors influencing them. Jochen Lau

# Carrots and cooperation. A comparison of two actors that formally are quite alike: Norwegian petroleum and maritime authorities

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**Keywords:** Power; Regulation; Maritime industry; Petroleum industry; Safety

## Abstract

Clear regulations and correct sanctions are often seen as regulators' tools to provide safety, implying inevitable power because of the regulator's formal authority. However, recent studies show that Norwegian maritime authorities are hampered by limited discretionary space (Størkersen, 2015) while the Petroleum Safety Authority deliberately uses vague unsanctionable regulations as a safety means (Antonsen, Nilsen, & Almklov, in review). Power can be seen as a 'relational state' as groups or individuals are unequal and influence the other (King, 2012, p. 348). Unfavorable as this may seem, power does not always connote a negative characteristic. Transitive power do restrict others' actions and use power over them, while intransitive power is facilitative, gives capacity and power to do actions otherwise not possible (as explained by Rosness (2013)). Power also provides a degree of social order, making it possible for authorities to enforce decisions and implement laws (King, 2012). Without authority, the legitimacy of power will not be recognized or acknowledged (ibid).

In this paper, the significance of the link between authority and power is analyzed by comparing two supervising authorities, with similar formal authority, in two related and partly overlapping industries. We analyze the Norwegian Petroleum Safety Authority (PSA) and the Norwegian Maritime Authority's regulations and interview statements about practical enforcement, to explore their power to regulate safety.

The PSA's role as a regulator is accomplished in a comprehensive manner. Their regulatory regime applies enforced self-regulation and issues broadly stated legal standards and functional requirements in defining enterprise responsibility (Lindøe, Baram, & Braut, 2012). This strategy allows them to exercise the three forms of regulation described by Baldwin, Cave, and Lodge (2011): regulation through a set of commands, deliberate state influence and other strategies that capacitate them with influence over the industry. Furthermore, it allows them to exert power in different dimensions, from power attributed to their formal position to power in setting the agenda and influencing the industry in adopting their goals and attitudes (Lukes, 1974). For instance, the introduction of the concept of a sound HSE culture in the Framework Regulations (PSA, 2013) provides a performance goal that grants the industry power to determine company-specific measures and degree of proceduralization (Lindøe, Baram, & Braut, 2013). Performance-based regulation acknowledges the regulator's limits and provides rules that do not stifle innovation (ibid). In summary, the PSA as a regulator exercises its power over the industry in leading them towards the improvement of safety and giving them power to find the best possible means themselves.

The Maritime Authority's also has the means of commands and different forms of influence over the regulated industry (as listed by for example Baldwin et al. (2011)). The safety regulation in the Norwegian Ship Safety Act (Lovdata, 2007) is mainly founded in the International Safety Management Code, which has one basic premise: The ship-owners are to make safety management systems to ensure safe operations. These functional requirements can give Norwegian ship-owners power to create procedures that is in line with their organization and activities (Kongsvik, Antonsen, & Størkersen, in review). Rather, bureaucratization has led to extensive safety management systems (Bieder & Bourrier, 2013; Dekker, 2014) and jeopardize practical seafarers' safety measures (Almklov, Rosness, & Størkersen, 2014; Walters & Bailey, 2013). The maritime industries' profit competition result in low budgets and not optimal safety standards, as well as limited discretionary space for the authorities (Størkersen, 2015). The regulator representatives experience that politicians, interest organizations and market forces set the agenda and influence the industry more than the regulator. As a result, the Maritime Authority experience that the industry is not ready for more power, and the authorities use their scarce resources to exercise power over the worst violators.



All in all we see that the Petroleum Safety Authority and the Maritime Authority have an unequal amount of power, although their formal authority is equal. In the maritime industry, the picture matches the general descriptions of the regulator's unhappy lot (Reason, 1997): Regulators are only favored with small budgets and means (Johnson, 2014; Walters et al., 2011), so large industry actors influence regulatory matters more than the regulators (Bratspies, 2009). The Norwegian Maritime Authority tries to use intransitive power to facilitate for the industry to increase their safety standard, but other are more powerful and decrease safety standards, so the carrots fall to the ground. The state in the Norwegian petroleum industry is totally different. PSA has power to set the industry's agenda and they use a range of measures to set high safety standards. They have transitive power, but are in the position to only use their intransitive power, to give power to the industry to make the right safety measures. The wealthy Norwegian petroleum industry does not seem to need sticks, only carrots and collaboration. Given appropriate resources and power, regulators are capable of lifting the standards of safety into a higher level (Rasmussen, 1997; Reason, 1997; Walters et al., 2011). Utopian as this may sound, it works to a degree in the Norwegian petroleum industry. Sufficient resources and power for the regulator and the industry do lift safety regulation.

# Preconstruction safety and health planning

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**Keywords:** Construction; designstage; Health and Safety; Architect; Principal

## Abstract

There is a saying 'rubbish in; rubbish out'. This can be translated to construction industry. A wonderful design that is hard to construct leads to unsafe working conditions. The architect and the structural engineer are largely responsible for health and safety in the execution phase. The choices these disciplines make about design and the use of materials are major factors in determining the possibility of safe building practices (HSE, 2004). Decisions in design still cause accidents during execution, maintenance and demolition. Research shows that about 50% of accidents are caused by decisions made in design. There is a saying 'rubbish in; rubbish out'. This can be translated to construction industry. A wonderful design that is hard to construct produces unsafe working conditions. The architect and the structural engineer are largely responsible for health and safety in the execution phase. The choices these disciplines make about design and the use of materials are major factors in determining the possibility of safe building practices (HSE, 2004). Research shows that about 50% of accidents are caused by decisions made in design. The European Directive 92/57 aims to address this issue and create awareness with all players in all phases. This directive is implemented in the legislation of all European countries. Countries outside Europe, have also implemented legislation similar to the European Directive. Did we learn from the past? There is a lot of research on Prevention Through Design. What is the impact of it. Involved parties still take little preventive action during the design stage. Most of the publications and instrument on this subject have offered solutions that can be implemented or checklists to monitor the design afterwards. But are those solutions implemented? Do we know if the actions that are executed are helpful for the execution of the object? Since 1994 there has been attention in several WOS conferences to health and safety in design. This attention among other actions should have resulted in changes in behavior of other involved parties. Yes, Designers and clients slowly feel the need to pay attention to health and safety. Instruments and methods are developed to support the designers in making the right choices. YES, it is possible to get a systematic approach of health and safety in design and get a more safe and healthy execution by using the right tools and applying the right knowledge. Knowledge is for example developed on the construction sites of the Olympic Games in London (HSE publications) as presented in WOS 2014. Technical University of Denmark (publications by K. Jorgensen) is very active. In an attempt to help designers, Arbouw developed a method for safety assessment in design phase (Frijters et.al., 2008a). This method can be incorporated into the design process for building elements and construction methods. What are the results, do we know the results of this work? This presentation gives a brief overview of some instruments and methods and how to use them during the design process. It will not be a complete overview, the aim is to inspire you. In the presentation you will meet the result of prevention through design in the Netherlands. We all struggled, pushed and towed for the past 20 years, and we need you to be able to thrive in all the years to come.

# Extending the effective range of prevention by hazard and accident investigations in virtual reality

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**Keywords:** accident analysis; virtual reality; ergonomics design principles; simulation; movement series

## Abstract

Investigations of incidents and accidents in industry and services remain challenging. This often is due to lack of information about potential causal relationships as well as lack of knowledge about how and what has happened under specific but unknown circumstances. Simulation-based methods such as virtual reality (VR) could provide assistance since it has been matured to support systems analysis, design and evaluation. Whether and how VR may be of benefit for accident analysis has been investigated based on data of a former VR study on usability and safety of safety measures for mobile elevating work platforms (MEWP)\*. In this former study, 20 participants performed inspection and driving tasks in an industrial hall in VR sessions of about 3 hrs each. During the sessions some incidents and accidents occurred in the virtual environment, i.e. virtual collisions of the MEWP or the driver with objects in the working environment, and the safety measure under investigation had several times been activated. Investigations of VR support for accident analysis, as presented here, referred to operational sequences and covered times before, during and after incidents and accidents or sequences of time when the safety measure under investigation in the former study was actuated. For all time sequences, continuously acquired data during task performance were analysed and visualised (e.g. time series of MEWP and operator movements in the work environment). This allowed for a dynamic reconstruction of each incident or accident in the virtual environment. It was also possible to identify when, why and how MEWP operators actuated the safety measure. Movement analyses and visualisations in combination with context of use information suggested potential explanations about what may have caused incidents or accidents and why they have not been avoided in given situations. Examples for potential explanations refer to, among others, impairment of human information processing due to lack of sight or systems design not conforming to user expectations, resulting in misjudgements of movements and mal-operation. Especially at accident prone locations (e.g. constricted openings) movements of the MEWP and the driver could be demonstrated, analysed and visualised for sequences of incidents and accidents in contrast to sequences without incidents and accidents. The results suggested that VR simulations in close to reality work scenarios can support accident analysis by improving insights into relevant processes and by providing potential explanations. The results from the simulation study could also be used to explore work systems design (e.g. safety distances, MEWP type to task fit) and help to learn about potential future incidents and accidents in real work situations and how to avoid them. Though analysis was retro-prospective and referred to simulated environments, hazards were simulated and perceived realistically without actually endangering operators. Simulation-based methods such as VR allow investigating safety measures in the relevant context of use (i.e. during incidents and accidents); they provide a brought range of tools and detailed information to investigate virtual incidents and accidents that may happen quite similar to those in reality. \* The study has been initiated and supported by the DGUV Expert-committee 'Trade and Logistics', Sub-committee 'Goods Handling, Storage and Logistics', and by the German Social Accident Insurance Institutions for the trade industries and freight logistics (BGHW) and for the metal and woodworking industries (BGHM)

# The current experience and training of Romanian occupational health and safety (OHS) professionals

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**Keywords:** Occupational Health and Safety Practitioners; OHS training; OHS requirements

## Abstract

The study it's a research about history of health and safety legislation in Romania, about European tools, empowerment procedures, organisations and association in the field. It's an overview about European tools to allow people free movements all around European Union (EU). The study presents tools which identifies the fundamental skills, the most important abilities and knowledge that people would need to be recognised, in order to allow free movements all around European employment market. The study is about possibilities to be voluntarily recognised as a health and safety professionals across EU and why not, around the world. It's a brief list of ways of transfer and recognition of learning experiences in Europe, including vocational education and training, for a better understanding of qualifications from different EU countries. The research presents ENSHPO (The European Network of Safety & Health Professional Organisations) and EUSAFE (European project) voluntary certification procedures for occupational health and safety professionals (OHS) and where the Romanian practitioners are placed, if their qualifications could be recognised through Europe. The research presents the necessary characteristics for a well developed profession, as mentioned by Ferguson and Ramsay (2010) and also presents IOSH, the most valuable health and safety professional association and the necessary steps for Romanian OHS practitioners to build such a strong association. IOSH it's the model of a profession and Romanian practitioners could learn to become Chartered Members. The European Union single market - as well as the increasing number of companies operating across Europe that are applying a consistent set of safety and health standards to their work sites - has created a great need for safety and health managers with credentials that are recognised at a Pan-European level. The absence of a harmonised, agreed system for the mutual recognition of safety & health qualifications at a European level creates uncertainty about professional competence across countries within Europe and may create problems for multinational companies in the effective use of their safety and health expertise. It also forms a barrier for safety and health professionals wishing to offer their services across the EU. Knowing the level of training is necessary to determine the training needs of OHS practitioners, now that Romania has joined the EU in order to allow free movement of the work force. Knowing where to start and what needs to be improved, will allow the Romanian practitioners to be just as good and compete with their European colleagues. The study will show which of the Romanian empowerment procedures was better, with or without examinations, and whether practitioners were more prepared than these days. The research is part of a study that aims to thoroughly analyze the transformation in the Occupational Health and Safety (OHS) field in Romania following the major political, economic, social and cultural transformations that are necessary in the context of Romania's accession to the European Union. The research evaluates the current experience and training needs of Romanian OHS professionals. A review of the changes in the legislation and qualification requirements in Romania will be presented and placed into the context of European legislation and standards.

# Measuring improvement of communication attitude toward railway safety through training in a Japanese train operation control center

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**Keywords:** communication; training; self-rating measure; non-technical skills; railway safety

## Abstract

This study examined whether communication training improved communication attitude toward safety in a Japanese train operation control center using a self-rating attitude measure. Recently, many industries have focused on non-technical skills to enhance operational safety. Accurate and smooth communication, in particular, is a core skill to improve team performance for safety. Training primarily aimed at improving team communication known as CRM (Crew Resource Management) training has widely spread in the aviation. And other industries also introduce communication training to improve team communication for safety. It is important to verify the benefit of such training from various aspects to provide training effectively. Training whose benefit is not verified is difficult to keep implementing. Instructors of training often observe trainees' behavior to check training effects. However, Instructors can't check unobservable aspects of training effects. Besides, checking detailed behavior during the training session becomes a burden for instructors. In particular, internal attitude is hard for instructors to check. Although forming attitude of putting high value on communicating accurately and smoothly for safety must be important, it is not clear whether or not such communication training actually improves the communication attitude toward safety. Thus, we developed self-rating communication attitude measure items and examined whether communication training improved communication attitude toward safety in a Japanese train operation control center. Accurate and smooth communication is necessary for train dispatchers to maintain railway safety. When a train accident happens, they have to gather information accurately from the train crew and the station staff, give proper instructions to them and share information smoothly with other dispatchers to make proper decisions. Our communication training required three different dispatchers, namely a crew and vehicle dispatcher, a traffic controller, and a vice-chief traffic controller to cope with an abnormal events scenario (e.g., railway vehicle trouble) cooperatively. After they finished the training session, they discussed the way they communicated during the session, watching video-recorded their operations. Thirty dispatchers took part in our ten training sessions for study. We measured dispatchers' communication attitude toward safety using self-rating communication attitude items. We developed 45 communication attitude measure items on the basis of previous communication studies and discussions with dispatcher instructors. The 45 items included eight items related to "proper timing" (e.g., In a state of emergency, tell the most important thing first.), 25 items related to "accurate information" (e.g., Don't use abbreviated and slangy words on the assumption that everyone knows the words.) and 12 items related to "appropriate response" (e.g., Repeat back certainly when you receive directions or reports). Dispatchers who took part in the training rated the degree of the importance of these items using a seven-point scale (1. Not important at all - 7. Extremely important) immediately before and after the training. In addition, to check the effect of the training toward communication attitude of everyday work, approximately one or two month after the training, both dispatchers who did and didn't take part in the communication training (additional seventy-three dispatchers) rated the degree to which they practiced the 45 items in their everyday work using a seven-point scale (1. Very untrue of me - 7. Very true of me). The results of ratings of the degree of the importance before and after the training showed that the average value of 12 items after the training was statistically significantly higher than before.

Typical examples of higher rated items were "In a state of emergency, tell the most important thing first.", "Don't use abbreviated and slangy words on the assumption that everyone knows the words.", and "Tell clearly from the other person's perspective." In addition, the results of one or two months after the rating of the degree of practice showed that dispatchers who took part in the training rated 18 items statistically significantly higher than dispatchers who didn't take part in. These results suggested that the communication training actually improved the communication attitude toward safety and it affected dispatchers' everyday communication practice even one or two months after the training. Although we neither studied the longer effect of the training nor observed the behavioral changes of communication, we confirmed that the communication training helps to improve communication for safety. The self-rating attitude measure is one of the effective and easy tools to check the unobservable effects of communication training.

# Occupational health and safety knowledge of students in secondary vocational schools in Croatia

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**Keywords:** Vocational Education; Occupational Safety and Health; Safety Practice; Young Workers; Safety Culture

## Abstract

Vocational secondary education aims to ensure the acquisition of competencies required for the labor market. Young workers are in accordance with the Occupational Health and Safety Act particularly vulnerable group of employees. Occupational Health and Safety Act states that particularly vulnerable groups for whom the employer shall be obliged to provide special protection at work are underage employees, pregnant employees, employees who have recently given birth and employees who are breastfeeding, employees suffering from occupational diseases and employees identified with a partial work capacity and a partial loss of work capacity or if there is an immediate risk of reduction of work capacity. Because of their inexperience, lack of practical knowledge, lack of awareness about safety and health risks, the inadequate supervision by experienced workers, young workers get injured more often than others. For this reasons the employer shall be obliged to provide special occupational health and safety for this group for the purpose of preserving his unimpaired mental and physical development. A minor may not perform work with special conditions, except for minors who have completed vocational secondary education for this work and who meet other prescribed requirements. For the purpose of minors' safety and health protection at work, the employer shall be obliged to adjust conditions and working time organization for the purpose of eliminating safety and health risks, to ensure other appropriate work at a workplace, if adjustments are not feasible or justifiable and to ensure the implementation of other occupational health and safety rules, in accordance with a special regulation. Students, as future young workers to be, in the framework of educational program, learn about safety at work, and gain their first practical experience in the practical workshops in school as well as in employer's workshops. Most influence on the development of safety culture among students have high schools teachers, practical training teachers and craftsmen where students perform professional practice. This paper presents the results of theoretical and practical studies of occupational safety and health in twenty eight secondary vocational schools in Croatia in which students study for professions: carpenter, chemical technician, agricultural technician, construction technician, graphic technician and forestry technician. Research was conducted in the period of two years by the Croatian Institute for Health Protection and Safety at Work. Study included total of 896 students who were surveyed in order to examine their knowledge and experience on occupational health and safety issues. The presentations were held to the students in order to emphasize the importance of safety at work before they complete their education. Students were familiarized with the most often hazards, harmful events and consequences, general principles of prevention, basic and specific occupational health and safety rules and employee's obligations and rights. The results of the survey of the above mentioned educational programs indicated the need for additional investment in the development of students' safety culture. As a result of the project Croatian Institute for Health Protection and Safety at Work developed the educational posters for the classrooms and school workshops and educational booklets for young workers entering the labor market.

# Health and good fortune! Organizational climate for health, safety, team effectiveness and innovations

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**Keywords:** Safety climate; innovative climate; occupational health climate; production effectiveness climate; Perceived organizational support

## Abstract

To be successful, an organization subjected to - sometimes global - competition must be efficient and productive and ensure high quality goods and processes, within highly restricted resources. But long-term success also requires the ability to provide good working conditions. This is important so that employees' safety, good health and well-being are sustained, as well as their work satisfaction and motivation to do the job at the best of their ability. In addition to this, the successful organization must be in the forefront in terms of generating and implementing new ideas and innovations in order to develop its processes and products. These three types of goals may be coupled to different aspects of the organizational climate. Organizational climate is often studied in relation to a specific domain, such as safety. The safety climate may then be defined as shared perceptions on the value placed on safety in the organization (Neal & Griffin, 2002). Different values, and thereby different domain specific climates, may be contradictory and competing in the organization, as suggested in the Competing values framework (CVF) (Quinn & Rohrbaugh, 1983). The necessity for organizations to attain several important goals may thus present paradox and goal conflicts. (Lewis, 2000) emphasized the importance of being able to cope with paradox in organizations and suggested that an effective approach to doing so was through transcendence, i.e., second-order thinking in terms of critically examining pervasive assumptions in order to construct an accommodating perspective on opposites. Lewis suggests that such transcendence may help to reframe organizational phenomena and thus make room for a dramatic change in meaning attributed to the relation between these. In these terms it may be beneficial to transcend from the first-order level of investigating organizational climate for specific desirable outcomes, which viewed in isolation may seem incompatible, to a second-order perspective that may help to reframe the relation between such climates, by applying organizational psychological theory to explain the mechanisms of interaction. **METHODS AND PARTICIPANTS** In the present project we investigated how five domain specific types of organizational climate, namely safety climate; occupational health climate; innovative climate; production effectiveness climate; and formal climate, related to four desirable outcomes in organizations, coupled to the organizational goals described above: employee health, safety, team effectiveness, and team innovations. The climate types represented the four quadrants of the Competing values framework (CVF) (Quinn & Rohrbaugh, 1983). We also investigated if a global climate, spanning the domain specific climates and predicting all four types of desirable outcomes, could be identified: a "G-factor climate". If, indeed, such a G-factor climate could be found, a third aim was to investigate if this climate G-factor could be substituted by a G-factor indicated by a selection of items identified as representing Perceived Organizational Support (POS), defined as employee perceptions that the organization appreciates employee contributions, and cares about their health and well-being (Eisenberger, Huntington, Hutchison, & Sowa, 1986). If a POS related climate G-factor could be identified, we wished to investigate if it had substantive predictive power on the four different outcomes: employee health, safety, team effectiveness, and innovations. The study was based on a questionnaire administered in four large industrial companies in Sweden; two in mining, and two in construction. 894 workers (65%) in 146 workgroups responded. Since organizational climate is a socially shared phenomenon, all analyses were performed at the



group level. **RESULTS** The results showed that a higher-order factor ("G-factor") was identified and could account for a substantial part of the common variation in measures of the investigated domain specific organizational climates. The content of this G-factor climate could partly be represented by the phenomenon Perceived organizational support (POS). The POS G-factor had predictive power for the outcomes employee health, safety, team effectiveness and innovations, which in general was equal or excessive to that of the domain specific climates alone. **DISCUSSION** The results indicated that POS is a valid higher-order organizational climate phenomenon, and a predictor of the investigated outcomes, essential for short-term and long-term organizational success. Providing organizational support as an overriding managerial principle may help employees to reconcile important but seemingly antagonistic organizational goals. As such, POS may support transcendence in coping with paradox in organizations (Lewis, 2000). Promoting the development of POS therefore stands out as an important aspect of successful management. We suggest, that an organization which, through its managers and structures, convincingly and genuinely shows that it respects and values its employees by caring about their well-being, and which shows appreciation of employee contribution by, in a wide variety of ways, providing support for the employees to participate and perform their work well, invokes trust, provides a source for self-esteem and helps to fulfil existential needs of meaningfulness and purpose. Such leadership is also likely to foster the development of supportive and trustful team climates. Within such a context, actors will have access to both individual and collective resources, and feel authorized and motivated to make full use of a wide repertoire of actions. **ACKNOWLEDGEMENTS** The study was financially supported by AFA Insurance and by the Swedish Research Council for Health, Working Life and Welfare (Forte), which is hereby gratefully acknowledged. **REFERENCES** Eisenberger, R., Huntington, R., Hutchison, S., & Sowa, D. (1986). Perceived organizational support. *Journal of Applied Psychology*, 71(3), 500-507. Lewis, M. (2000). Exploring paradox: toward a more comprehensive guide. *Academy of Management review*, 25(4), 760-776. Neal, A., & Griffin, M. A. (2002). Safety climate and safety behaviour. *Australian Journal of Management*, 27(Special Issue), 67-76. Quinn, R. E., & Rohrbaugh, J. (1983). A spatial model of effectiveness criteria: towards a competing values approach to organizational analysis. *Management Science*, 29(3), 363-377.

# Mobile telephony and RF exposure: the experience of Brazil (MG)

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**Keywords:** Mobile Phone; Non-Ionizing Radiation (NIR); Radio Base Station (RBS); MPL (Maximum Permissible Levels); TLV (Threshold Limit Value)

## Abstract

With more than 7 billion mobile phone users in the world, whose operation is based on the emission / reception of non-ionizing radiation, the possibility of harmful effects to human health due to exposure to RF electromagnetic waves is a global concern. It is observed that the rapid expansion in mobile services including Brazil (circa 230 million users), is increasingly producing discussions on civil society in general, about the possible correlation of damage to health and exposure to electromagnetic fields from such systems. While cell telephone service in itself is not high powered, the increasingly use of shared high density antenna towers at sites with a number of antennas mounted at low heights (in some instances high power TV and Radio antennas may be co-located), and frequent need for personnel to work in proximity of base station antennas, may result in workers being exposed to high levels of RF radiation. Nowadays, finding suitable antenna sites is not an easy task, due mainly to the concerns of the community. The question to be analyzed in this study relates to the mechanisms of risk perception of the resident / working population in the vicinity of Radio Base Stations (RBS) in relation to levels of radiation they are exposed and their possible health risks. The study is based on analysis of existing literature, as well as case studies with field measurements, made in the vicinity of the antennas in operation (a total of more than a 1000 antenna sites were assessed), using appropriate instrumentation – RF broadband field density meter equipped with isotropic antenna (probe). Several types of antennas and their radiation diagrams are studied and the concepts of non-ionizing radiation versus ionizing radiation are presented. The measurement results obtained are compared with the exposure limits set by the ICNIRP – International Commission on Non-Ionizing Radiation Protection, based on recommendations from WHO (World Health Organization) / Brazil's National Telecommunications Agency - ANATEL (Resolution No. 303/02). Also, the levels of radiation emitted by other radiant systems, such as antennas of TV and AM / FM radio stations are confronted. Finally, from the field data collected and compared with the TLV's established; a discussion of correlation between exposure and possible human health risks is presented, taking into account the fact that without doubt the total level of human exposure to RF radiation is increasing at a fast rate due to the presence of new sources, such as: military, satellites, surveillance, appliances, magnetic resonance imaging, inductive heating devices, traffic radars, internet, etc. Therefore RF fields measurements at (and in the vicinity of) the antennas sites, is a must for certifying site compliance with the ICNIRP / Anatel exposure limits for both controlled and uncontrolled environments. The results of field measurements at about 1000 worksites containing mobile telephony (cell phone) antennas, are presented. The survey was performed with a RF broadband field density monitor equipped with isotropic probe. The measurements were taken around the base of the antenna tower and at the service platforms and close to the antennas, where workers stand to do their tasks such as antenna maintenance and alignment and signal light bulbs replacement - all done with the station equipment fully activated. The results of the measurements are confronted with the legal exposure levels and a certificate of compliance is issued providing important conclusions and recommendations to protect the safety and health of the workers. "It's up to us to inform and train the workers about the possible risks of human exposure to RF/NIR!" BIOGRAPHICAL INFORMATION Carlos Queiroz holds a B.S. degree in Mechanical Engineering with Post-Graduation in Safety Engineering and M.Sc in NIR. Carlos Queiroz is a member of the CREA - Brazilian Society of Professional Engineers and Vice-President of "SOBES" – Brazilian Society of Safety Engineers. He has been working in the field of non-ionizing radiation as a researcher, professor and lecturer at several seminar and schools, focused at the protection of workers and the general population.

# Integrated management systems as complex adaptive systems

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## Abstract

It is a difficult task to avoid the “smart systems” topic when discussing smart prevention and, similarly, it is a difficult task to address smart systems without focusing their ability to learn. A major distinction between systems can be drawn between those that have such ability, i.e., those systems that have “memory” and those that have not. These former systems are often depicted as adaptive since they take into account past events to deal with novel and similar future events modifying their structure to enable success in its environment. Often, these systems, present a nonlinear behaviour and a huge uncertainty related to the forecasting of some events. The systems approach is a paradigm of the current science. This concept evolved after the realization by the academic and industrial communities that the decomposition of a system under study into smaller sub-systems, or components, provides relevant information but not explain all the original system behaviour. This seems to concur with the notion that a system is more than the sum of its parts. “Complex adaptive systems” is a research topic that encompasses the most different systems typologies either in dimension, degree of complexity, agents involved, physical or organic nature. One may state that there is not a peculiar research environment where this topic is studied and the contributions provided by the research into a distinct system typology may be valuable to other systems presenting different characteristics but encompassing the features that enable them to evolve as CASs. According to the literature, the term CAS has different meanings to different researchers and a consensual definition seems to be a difficult task among academic experts but it is possible to list the agreed properties that CASs should present. The revised literature pointed out the adoption of CASs related methodologies to study ecological and biological systems, social systems, organizational systems and management systems, supply chain networks and information systems, among others. Other papers deal with the abstractive features of the CASs concept, namely, listing the key elements, on how to control and efficiently manage them, on the development of methodologies to assess them and their complexity and on the identification of their mechanisms. In addition, a significant number of papers focuses CASs modelling, the transfer of the theoretical concepts to a real world environment, the proposal of representational tools and improved visualization, the underlying mathematical theory to the concepts and how to engineer them. IMSs are systems of systems and, from a viewpoint of the CASs, are complex adaptive systems of systems (CASoS) a concept proposed and adopted by several authors that depict systems where the primordial components are themselves systems, CAS or not, with several agents interacting internally and some features interacting beyond the original boundaries with other features from other sub-system(s). Evolving from a single CAS to a CASoS demands a compulsory redefinition of the boundaries, the assessment of the newly interactions arisen, the identification of novel emergent features and of all the dynamics involved. IMSs encompass several agents such as people, entities and organizations among other. Additionally, IMSs are standardized and certifiable organizational systems implemented by organizations that intend to fulfil several stakeholders’ requirements, usually, the customers’ requirements (according to the ISO 9001 standard), the environmental requirements (according to the ISO 14001 standard) and the employees safety requirements (according to the OHSAS 18001 standard). In addition to the implementation of these standards it is possible to find out IMSs combining other management sub-systems seeking to fulfil several sector specific requirements such as the ISO/TS 16949, the ISO 50001, the ISO/IEC 27001, ISO 13485 and the ISO 22000. Several synergies could be developed when researching IMSs adopting a CASoSs approach. On one side, although the scientific context may differ from each identified CASs, they all share the same set of properties and, inherently, the methodologies to be adopted to deal with one of them may be valid to deal with all the others. In fact, the opportunity to extend the scope of the research of IMSs from the “claustrophobic” and classic management

and systems engineering topics should not be wasted. On the other side, CAS academic community will certainly welcome the contribution from a new field with a remarkable diversity of agents often operating in turbulent environments and encompassing social, human and organizational nonlinear interactions. The following features characterize IMSs as CASs: - Multiple agents: A IMS encompasses multiple agents (people, organizational structure, equipment, customers, society and regulatory requirements, etc.) interacting each other. - Learning: A IMS is an adaptive system, that is, past experiences condition present and future behaviour. - Emergence: The structures of an IMS emerge from patterns that have their source in the standards and experience. In addition, some common features (or patterns) may be detected not being dependent on the geographic location, company dimension, activity sector or organizational culture. - Complexity or nonlinear behaviour: the interrelationships developed among its elements originate nonlinear emergent behavior in which the complexity is higher than the sum of behaviors of its parts. This paper seeks to portray the integrated management systems (IMSs) as complex adaptive systems (CASs) by listing their properties and discussing the features that enable them to evolve and self-organize in order to, holistically, fulfil the requirements from different stakeholders and thus thrive by assuring the successful sustainability of a company. Based on the revision of literature carried out, this is the first time that IMSs are pointed out as CASs which may develop fruitful synergies both for the management systems and for CASs communities. By performing a thorough literature review and based on some concepts embedded in the “DNA” of the sub-systems implementation standards it is intended, specifically, to identify, determine and discuss the properties of a generic IMS that should be considered to classify it as a CAS.

# The influence of the crisis on OSH management: identification of the key indicators

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**Keywords:** Crisis; Commitment; Indicators; Occupational Safety & Health

## Abstract

The Eurozone is facing an economic crisis as a result of a turmoil that affected capital markets since 2007 and that was intensified in 2010. Portugal is one of the European countries where the effects of the crisis were more prominent. This situation is having an important impact in Portuguese companies. The most affected dimension was the Small- and Medium- sized Enterprises (SMEs). This factor has a negative impact in the economic competitiveness, as this type of companies is responsible for the employment of two millions people. In view of the financial unsustainability, this country required foreign aid and austerity measures have been implemented. In consequence, companies are having to adjust their priorities regarding the investments namely in the Occupational Safety & Health (OSH). In fact, companies are dealing with limited financial resources, and as a consequence, they need to make decisions about financial resources, being the management strategies for productive process often dissociated from OSH issues. As a result of these kind of organizational policies, the workers' health and safety could be compromised. In fact, a report conducted by the International Labour Office from Geneva showed evidence that the global economic crises that is affecting some of the European countries is responsible for lack of commitment by the enterprises on the OSH issues. A previous study developed by the authors, surveyed almost 600 persons in Portugal (External environment) in order to analyse the perceptions of the employed population about the influence of the crisis on OSH outcomes. Issues related with workers' finances and job security, as well as, the influence of the crisis on risk acceptance, risk exposure, employers' OSH commitment and prevalence of psychosocial risks were investigated. Results showed evidence that the crisis has an important impact in the analysed situations. As conclusion, it was highlighted the relation between the effects of the crises and the management commitment with health and safety and in psychosocial aspects of work. Indeed, companies are compromising their health and safety performance due to the fear of the crisis consequences to them, making the improvement of OSH a challenging task. To establish the status of this commitment and analyse the real impact of the crisis in companies' safety performance, a study was conducted. The main objective was to identify through a literature review the key indicators of safety performance that allow to characterize the relationship between the crisis and the safety practices, safety of the work environment and occupational accidents. A literature review allowed the identification of several indicators such as: Employee empowerment, Interrelationships, Management commitment to safety training to identify safety problems and generate preventive actions, to invest in good practices, personnel protective equipment and machines and equipment maintenance, Safety management system and Individual safety. To verify if these indicators were adaptable to the Portuguese occupational context, a checklist was made containing the indicators. The checklist was applied in two SMEs. Results will allow establishing a list of indicators that will be used to develop an observation tool to define the status of the SMEs (internal environmental) regarding the OSH commitment.

# **An activity-theoretical perspective on safety training within new employee introduction: three cross-national cases from a multinational company in the manufacturing wind industry**

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**Keywords:** activity systems; new employee induction; safety training; organisational culture

## **Abstract**

This study offers a challenging contribution to research around learning practices in a culturally diverse multinational company. The overall focus is on the development of reliable systems for safety management to prevent accidents and to develop a sufficiently safe working culture. In doing so, the study explores three different settings of this company, which are located in China, India and the USA, and where the production processes are largely identical. At the same time, these settings represent their very own sociocultural context, for example, each of them has a history of being independently organised, and only recently, there have been managerial attempts to unify selected work processes. In particular, the goal of the project is to more fully understand activities and actions in complex and diverse learning environments, including their contradictions and interplay from a global perspective. This provides valuable insights into the causes of cultural disparities and similarities in approaches to learning in the three different settings. Burke et al. (2006) undertook a first attempt to unify the discussions of the implications of learning theory and research for safety and health training research and practice. Safety and health training practices in larger organisations are usually coordinated within a Safety Management System (SMS), which have been described from a learning perspective by Rocha et al. (2010). The presented study expands on these theories by applying a sociocultural perspective when investigating safety-learning activities, more specifically the 3rd generation activity theory (Engeström, 1987; 2009). This approach constitutes a resource when teasing out the complexities involved in human activities and actions by offering analytical tools for mapping and evaluating complex learning interactions in natural environments. In this way, we argue that each of the three settings represents separate and, at the same time, unified activity systems; related to specific cultural and historical processes, but also sharing common goals. The study targets a redesign and transfer of HSE-training activities into daily practices that are situated at the workplace of industrial production. Methodologically, the study is based on a case study approach. Data have been collected through observations, focus group interviews, informal conversations, visuals (e.g. photography), and documents (e.g. Training material, schedules, procedures). The unit of analysis is activities and actions related to safety learning processes in natural environments. The study includes shop floor workers of a chosen production shift and each of the four main production steps in an industrial manufacturing setting involving a range of heavy manual work, where major risks for health and safety are inherently present. Hence, cultural differences and similarities in safety behaviour related to specific learning practices naturally become apparent for investigation. Preliminary results show that individual choice of training tools indicate different culturally influenced approaches to learning, which are (1) an action learning approach, (2) a process-simulation approach and (3) a Training-Within-Industry (TWI) approach. The full paper elaborates and explores how sociocultural theory, in particular emphasising activity systems connected to a global and situated focus on learning in complex and diverse environments, can explain how safety learning takes place among shop floor workers in a multinational industrial production.

# Effect of fatigue on the safety of waste transport workers

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**Keywords:** driver; break; accident risk; timetable

## Abstract

Waste transfer is an example of work in which unpredictable events sometimes occur and workers need to make quick decisions in order to complete all the tasks on their timetable. In addition to working to tight schedules, waste transport requires continuous alertness due to the risks that workers face. Particular alertness is needed for work in traffic.

Alertness decreases if a driver is fatigued. Fatigue is an accident risk for waste transfer workers, as it significantly increases reaction times and weakens driving performance. Working while fatigued can negatively affect well-being and safety at work. The objective of this study is to increase the knowledge regarding well-being and accident risks in waste transportation work, thus improving occupational safety.

The data were gathered from the “Improving resilience in waste transfers” study in 2014. The study material consisted of a questionnaire among the waste transport workers of two companies in Finland, which had 90 questions related to the work characteristics of waste transport and waste collection. The total number of respondents was 201 (i.e. response rate 45%).

The question about fatigue was “Do you often feel fatigued during work shifts?”. The accident risk was valued in five level rating scale between “almost non-existent” and “very high”. The question about having breaks was “How often do you pass having breaks” in a five level rating scale between “daily” and “never”. The possible reason for not having breaks was completed by choosing one of five alternative reasons.

Of the respondents, 32% reported often feeling fatigued during their work shifts. The workers who recognized their fatigue considered the accident risks at their work to be higher than those who did not report feeling fatigued ( $p < 0.05$ ).

The fatigued drivers also reported having less breaks during their work shifts than other drivers ( $p < 0.001$ ), and that their management placed less importance on following safety instructions than they did on efficient completion of work tasks ( $p < 0.001$ ). Fatigued drivers reported more than other drivers that tight work schedules are the reason why they don't have breaks during work shifts ( $p < 0.005$ ).

The safety instructions of each company applied to all employees within that company. However, there was a feeling that management has more respect for workers who perform their tasks quickly or are able to complete their entire work list during their shifts rather than for those who follow these instructions. This dilemma exists especially during difficult winter-time weather conditions, when traffic is slower. The shared feeling among drivers about following safety instructions as not as important as efficient work reveals that the importance of safety communication requires more attention, and that all organizational levels need to be more aware of the importance of safety. Previous studies have stated that coercive pressure to get work finished sometimes leads to unsafe working behavior, which in this study is seen as driving without adequate breaks. This is a challenge for employers, who are responsible for the safety of workers as well as for following laws and regulations, as this also puts time pressure on workers.

# The trajectory deviation, a new methodology for safety evaluation

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**Keywords:** Automotive interfaces; mental workload; Driver distraction; Trajectory deviation

## Abstract

Vehicles contain many systems that are not specifically for driving, but are, instead, for supplementary functions such as air conditioning, radio/multimedia, and more (Jonghyun Ryu, Jaemin Chun, Gunhyuk Park, Seungmoon Choi, & Han, 2010). Functions as satellite navigation, parking help, cell phone hands-free and accessories, seat adjustments, ride adjustments, engine and mechanical adjustments, and on-board computers are other examples of functions actually available in the automobiles. As technology evolves, an increasing number of supplementary functions are added. Inevitably, the complexity of the function controls also increases. All these systems inside cars need physical interfaces in order for being manipulated by the driver during various driving conditions. Ryu et al. (2010) also refers that these kinds of systems require the driver's visual attention for selecting the desired functions, which can increase the probability of having an accident. This has been a great challenge for car manufacturers around the world, as they try to create the perfect solutions combining great interactivity and ease of use of the systems without compromising the driving safety. Driver distraction is a term that defines the deviation of focus from the primary task of driving a vehicle, to a secondary task, consequently diminishing the performance of the primary one. The causes for this distraction can be of an immense range of possibilities, but they emerge from the effects of perturbation of certain human resources required for driving, so they can be arranged in a few types. According to the National Highway traffic Safety Administration (NHTSA) there are three types of driver distraction that can affect drivers in different ways (Department of Transportation, n.d.): Visual distraction, tasks that require the driver to look away from the roadway to visually obtain information; Manual distraction, tasks that require the driver to take a hand off the steering wheel and manipulate a device; cognitive distraction, tasks that require the driver to avert their mental attention away from the driving task. The tasks performed by drivers can be of one, two, or all three of these distraction types at a time. The main objectives of the present work were to understand: How much are the actual automotive central consoles safe and helpful to the driving task; How effectively can we measure the driver distraction while driving and performing tasks on the central consoles. It is expected that from this analysis some conclusions could be achieved that should lead to an improvement opportunity, that could result from a combination of the systems, or could even give opportunity to develop an alternative new solution or a good practice guide for future developments. A centre console design guide could be developed, in order to allow the carmakers, and designers to create more user-friendly automotive environments, and to improve driving safety. The used methodology recurred to a driving simulator in order to present a highly immersive driving experience, with physics accuracy and the ability to have telemetry to export the acquired driving data. The main metric indicators used were trajectory deviation, eyes-off-the-road time and self-perceived workload. The presented methodology was proven valid to evaluate in-vehicle systems that depend on human interaction, but the realism and immersion of the experience must always be as better as possible. This methodology provides a way to relate what was found as the most important indicators about the driving performance and their retrieved data, in order to create a classification system that allows the definition of a system performance. This relation between indicators makes possible to evaluate human-machine interaction systems in terms of physical and psychological factors in a realistically simulated driving environment, without accident risk



and with a low budget solution. The presented solution allows the acquisition of a great amount of data not only about the driving task itself, but also of all the associated tasks and systems that may be created and tested in a realistic driving environment.

# Occupational safety in a globalized construction industry: a case study on Polish workers in Norway

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**Keywords:** occupational safety; migrant workers; construction industry

## Abstract

A moving work force is globalising the construction industry. After the expansion of the European Union (EU) in 2004, the number of migrant workers from the new member countries rose across Western-Europe. In Norway, Polish workers are the largest group of migrant workers and the number is continuously increasing. Polish migrant workers are particularly well represented in the construction industry, which is one of the most risky industries in Norway. In 2014, one-fourth of the work related fatalities in Norway happened in the construction industry. Furthermore, research and statistics show that migrant workers are more prone to occupational accidents than native workers; 36 per cent of the fatalities in the construction industry in Norway in 2014 involved migrant workers. Poor communication and lack of lingual skills are often pointed out as important factors for the accidents. There are however several other factors influencing occupational safety of migrant workers, such as culture, organisational aspects and individual factors. A study was conducted to explore how the use of migrant workers in the construction industry influences communication and thus occupational safety, with emphasis on culture and language. To get a broad perspective both migrant workers, represented by Polish workers, and native workers, represented by Norwegian workers in were interviewed. 18 interviews were conducted in the native languages of the informants, which gives first-hand information to the researcher. The informants were employed in six companies and four position were represented, namely managers, foremen, skilled workers and union representatives. It was found that the focus in the construction sector in Norway concerning migrant workforce is mainly on language as an issue, as most measures found were related to language. Culture is seen as a contributing factor for safety issues, but is somewhat neglected and few measures are being implemented for cultural challenges. This factor is however important for risk perception, safe behaviour and not at least for communication. The study demonstrates the importance of the cultural factor for communication and thereby also safety. Furthermore, Polish workers are often seen as a homogeneous group, whereas in reality there are large differences between individuals and their risk perceptions and behaviour. Also organisational factors such as employment contracts and use of temporary work force, work arrangements with working groups arranged according to nationalities, and competition in the market about the jobs influence the safety at work for migrant workers. This shows that factors that affect occupational safety for migrant workers are compound, and thus the factors must be seen together in a broader, more complex perspective. A focus solely on language as it often is in the sector today is too narrow. To cope with the challenges, involvement of more levels is crucial, such as governmental level that is in charge of legislation and inspections, sectorial and organisational level that set the ground rules for the projects, and individual level where every workers is on daily basis responsible for own safety. The safety in the sharp end in large degree depends on how conditions are framed and what factors are emphasized at the higher levels.

# Nanotechnology– balancing accident reduction with potential health risks in construction

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**Keywords:** nanotechnology; construction; health

## Abstract

Nanotechnology involves working at a sub microscopic level with particles or structures which are 1-100 nm in size – one nanometre being a billionth of a metre. Nanotechnology has the potential to reduce certain health and safety risks in the construction industry. It also offers improved material functionality and performance. However, there are unresolved concerns regarding the health risk from some nanomaterials. It is important that the adoption of these new materials does not increase the risk of occupational ill-health, described by Gibb et al (2006) as a 'slow accident'. The IOSH-funded research on which this paper is based is assessing the use and benefits of nanomaterials in construction through literature review and interviews with industry stakeholders. The research is also exploring the potential for harm, particularly during demolition and recycling at end of life, by testing nano-enabled construction products in a laboratory environment. The benefits of nanotechnology – reducing worker risk European Directives put requirements on designers to consider the health and safety of those who construct, maintain and demolish our buildings and infrastructure, and nano-enabled products can be a part of this. For example, self-cleaning glass (containing nanotitanium dioxide) reduces accident risk by negating the need for workers to access difficult high-level areas in order to clean windows – the rain does the work for them. Self-compacting concrete (containing silica fume, which is a nano-form of silicon dioxide) removes the need to vibrate wet concrete and to powerfloat the surface to make it flat and smooth: both of these operations being ones which are significant contributors to hand-arm vibration and other musculoskeletal disorders. An example from outside construction is the use of nanosilver. This is incorporated into paints and coatings where its antimicrobial properties help reduce the risk of infection spread in healthcare environments, protecting both staff and patients. The risks of nanotechnology However, nanotechnology also brings potential risks. For example, some of the desirable functional properties arise from the increased reactivity of the constituent particles, a consequence of their very high surface area-to-mass ratio; but this increased reactivity might also increase their potential for harm. This has led NIOSH in the USA to set a recommended airborne exposure limit for nanotitanium dioxide of 0.3 mg/m<sup>3</sup> (NIOSH 2011). This compares to the limit for non-nano titanium, which is 2.4 mg/m<sup>3</sup>. However, the likely health risk also varies substantially between different nanomaterials. One which has caused particular concern is Carbon Nanotubes (CNTs) which can have asbestos-like effects due to their needle like shape and bio persistence. NIOSH has set an airborne limit here of 0.001g/m<sup>3</sup> (NIOSH 2013), although it is important to note that not all CNTs appear to be similarly toxic. The risks arising from nano-enabled materials are clearly important for those working in production but are also of concern for those in the construction industry who are using the products and those who demolish buildings at end-of-life. Finding a balance One way of minimising the risk from nanomaterials is to only develop applications for those which are less toxic. For example, silica seems to be one of the most widely used nanomaterials in the construction industry, being included in many surface coatings and some insulation materials as well as concrete. The risk from nanosilica is generally considered to be low to medium compared to other nanomaterials (Napierska et al 2010, Som et al 2014). Selecting safer forms of particular materials is also

important –for example short, tangled CNTs are recognised as being less hazardous than longer ones (Donaldson et al. 2013). An additional control mechanism is to stabilise nanomaterials such as CNTs within a matrix to ensure that free particles are not released during use or disposal. However, it is important that such a matrix remains stable over time in the face of challenges such as weathering and maintenance; and ultimately at demolition, recycling and disposal. There is still insufficient data regarding the hazard potential of nanomaterials to support good decision making on their use. A particular risk is that as materials become cheaper and more widely available, their usage may increase outside their original scope, so that any risk becomes disproportionate to the benefits. This is illustrated by an increase in the use of nanosilver outside of healthcare environments – it is added, for example, to socks, washing machines and hairdryers. Whilst there is no strong evidence for its toxicity to humans, concerns have been raised regarding adverse environmental consequences and the development of microbial resistance (SCENIHR 2014). CNTs are only just beginning to be used in construction, with their inclusion in some specialist coatings as well as pre-commercial trials for use in concrete. It is difficult to predict which forms may be used in the buildings of the future, or even which ones may be in use currently; and whether their potential to cause harm is taken into account when selecting them, and whether it outweighs the benefits they might bring. Nanotechnology offers substantial societal benefits, and can contribute to improved health and safety in many arenas. It is essential however, that this is balanced by an accurate understanding of any additional risks which may arise from its application. Donaldson, K. et al 2013. Pulmonary toxicity of carbon nanotubes and asbestos - similarities and differences. *Advanced Drug Delivery Reviews*, vol. 65, no. 15, pp. 2078-2086. Gibb, A. G. F. Occupational health: slow accidents need solutions fast. *Global Unity for Safety & Health in Construction*, Proc. of CIBW99 Int. Conf. 2006. Napierska, D. et al, 2010. The nanosilica hazard: another variable entity. *Part Fibre Toxicol*, vol. 7, no. 1, pp. 39. NIOSH, 2011. CURRENT INTELLIGENCE BULLETIN 63 Occupational Exposure to Titanium Dioxide, [viewed 2015, May 19]. Available: <http://www.cdc.gov/niosh/docs/2011-160/pdfs/2011-160.pdf>. NIOSH, 2013. CURRENT INTELLIGENCE BULLETIN 65 Occupational Exposure to Carbon Nanotubes and Nanofibers, [viewed 2015, May 19]. Available: <http://www.cdc.gov/niosh/docs/2013-145/pdfs/2013-145.pdf>. SCENIHR, 2014. Opinion on Nanosilver: safety, health and environmental effects and role in antimicrobial resistance Scientific Committee on Emerging and Newly Identified Health Risks, European Commission. Som, C. et al, 2014. LICARA Guidelines for the sustainable competitiveness of nanoproducts Dübendorf, St. Gallen, Zeist.

## Apprentice or student – a question of safety?

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**Keywords:** vocational education; identity; role conflict; safety practice

### Abstract

Background There continues to be high numbers of workplace injuries in the construction industry. An interesting difference in injury rates exists between the two Nordic countries Sweden and Denmark, the latter having a 40% higher rate of fatal occupational injuries in construction. As part of a larger research project looking at finding contributory national, organisational, and individual explanatory factors for the difference between the two countries (The SveDan project), this sub-study compared structural components of the Swedish and Danish Vocational Education and Training programs, and examined how the vocational students' identities as students and/or apprentices influenced occupational safety practices and experiences. Methods This analysis is based on a qualitative multi case study of carpenter education and training at three Danish and three Swedish Vocational Education and Training programs (the vocational schools). The schools were strategically selected to represent large and smaller schools, and to be located in major cities as well as in smaller urban areas. Document analyses were carried out focusing on laws and regulations relevant to the education systems, as well as on documents provided from the schools. Observations and interviews were conducted over a period of four months between September 2014 and January 2015. One Swedish and one Danish researcher spent three days at each school, initially observing the school shop floor classes, and subsequently conducting interviews. A total of 14 teachers and 30 students (interviewed in 11 focus groups) were interviewed. At some of the schools selection of interviewees was done by the school program planner, while at others the interviewees were asked by the researchers if they would participate. A semi-structured interview guide was applied in order to be able to explore issues that had come up in a previous questionnaire study as well as other issues. The interviews were all recorded and transcribed verbatim. The analysis applies a socio-cultural approach, viewing occupational safety as an integral part of the social activities of a community of practice. Identity is thus understood as a competence to participate in a certain social practice. This perspective directs the analyses towards the different communities of practice that the students are a part of at school and at work, and is thus aimed at exploring the potential conflict of roles the students might experience while moving between school and practice/work. Results In the two countries, occupational health and safety education has been integrated into the vocational education programs, in an effort to strengthen safety knowledge and awareness among the younger generations of construction workers. Given the close connection between educational and occupational practices in vocational education and training programs in both countries, this focus on safety training in the schools seems like a productive way of trying to improve safety in the industry. There are however structural differences in the organisation of workplace learning between Denmark and Sweden that might influence the students' possibilities of using their safety knowledge at work. In Sweden vocational education students are enrolled in a three year upper secondary education program. In the second and third year the construction work students normally work with a company 2- 3 days a week, and the other 2-3 days are back at the school. It is the teachers' responsibility to find a company placement for the students, and the students are not employed by the company. It is only after three years of vocational education and training that they are employed as apprentices. In Denmark on the other hand, vocational educational students within construction enrol in an almost four year program. After an introduction course of 20-40 weeks, the students themselves need to find employment as an apprentice in one or more companies in order to be able to continue their education. As apprentices they alternate between shorter periods at school and longer periods with a company. Their employment normally continues

during the school periods, but the companies receive compensation when the apprentices are at school. This structural difference in the organizing of the vocational education and training means that the students in Denmark are employed apprentices that go to school, but are the responsibility of the company and answer to the company, whereas their Swedish counterparts are students that have practice in companies, but are under the responsibility of the school and answer to their teacher. There is thus a structural difference in the way that the construction worker education system is organized between the two countries. A previous questionnaire study showed Danish students experienced a higher level of role conflict than the Swedish students. The qualitative analyses in the current study point to the differences in role conflict as being related to differences in identity – as a student or an apprentice. Identity affects the way the students see their role in the company they work in, the way safety is practiced, and the way that teachers understand their role in relation to the students and their occupational safety. Conclusion Structural differences in the carpenter vocational education and training system between Denmark and Sweden may influence safety attitudes and practice among carpentry students.

# Improvements in risk assessment of occupational risks

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**Keywords:** Risk assessment; WebORCA; Fine & Kinney; Occupational accidents; Evidence base

## Abstract

The European directive 89/391 asks companies to perform a risk assessment to help prevent occupational accidents and ill health. However, at EU-level there are no fixed rules about how risk assessments should be undertaken. There are tools that can be used, such as the OIRA tool at the EU OSHA site but in practice often the Fine & Kinney method is used. Fine & Kinney uses information on the probability of identified hazards to occur, the exposure to the hazards and the severity of possible injuries linked to the hazards to calculate a number, the risk index. The risk index can be used for a number of applications: - to determine a ranking of possible risks to have a general idea of the relative risk - to assess these by comparing to given levels of acceptable/unacceptable risk - to decide which possible measures or routes can be chosen to reduce the risks by recalculating the risk with new probability, exposure or severity. The method is called (semi)quantitative as it uses and produces numbered values. However, in practice the probability and the exposure usually need to be estimated or assessed and often have no evidence base. Thus, calculation of risk indices by different assessors can differ quite substantially. Also, there is no clear method for identification of hazards. For occupational risk we think there is a possibility to identify hazards and prioritise the associated risks from an evidence base with the WebORCA tool. The tool was developed in recent years and contains data from a number of sources. Serious accidents, that were reported to the Dutch Labour Inspectorate, were analysed to categorise them into different hazard types with different underlying causes. Next, the exposure to these hazard types for all workers in the Netherlands were determined, as well as the general working conditions, in a number of surveys. Combining the data resulted in the ORCA (Occupational Risk Calculator) model, that was converted into the web application WebORCA. WebORCA will calculate the risk of serious occupational accidents based on input of data on employees, activities, duration of activities, proximity to hazards and the status of the working conditions. The calculation results in a ranked list of risks for the different hazards at company, job or employee level. These can be matched to the Dutch National Average (DNA) for comparison. In this presentation an example will be given of the use of the WebORCA tool in an aluminium smelting company. The company had calculated the risk with the Fine and Kinney method and had assessed the risks for several jobs to be acceptable. They were interested in a calculation of the risk with the webORCA tool as it uses data based on actual accidents and exposures. A calculation was conducted for a smelter by using the different activities (smelting, changing anodes and miscellaneous activities), duration of activities and exposure to hazards, given by the company and adapted after a further discussion with the ORCA consultant. As it was not known how the working conditions compared to the DNA, 3 scenarios were used for a calculation assuming worse, average and better conditions than the DNA. The results showed that the risks for serious accidents resulting in death, permanent injury and recoverable injury were a factor of 5-8 higher than the DNA, assuming the working conditions to be average. This changed their thought on acceptability of the risks. Further analysis showed the smelting itself to be the largest contributor to the risk and for that activity the highest scoring lethal hazards were determined to be "Contact with falling objects – crane or load" and "Hazardous atmosphere through breathing apparatus". With this insight the company can now target these hazards more precisely with measures. The measures can be inputted in WebORCA to determine the effect on the risks assessed, to find the most effective measure.

# Risk management and governance of hazardous industrial areas - enforcement by legal rules and negotiated social contracts

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**Keywords:** Risk Governance; Social Contracts; Hazardous Industry; IRGC-framework

## Abstract

Major accidents involving fires, explosions, and massive releases of oil, chemicals and gases often kill or severely injures workers and citizens as well as impact the environment as demonstrated in Seveso (1976), Bhopal (1984) and Toulouse (2001). Therefore, efforts to prevent major accidents are of great importance to safety and health for workers as well as the local population. There is ample evidence that improving government regulation, industry self-regulation, and safety management could be proactive means. With industrial areas including logistic hubs, harbors and larger groups of individual firms, negotiation with communities and interest groups becomes an additional means of preventing major accidents and emergency response and thereby protecting the workforce and the neighbors. Whether these risks are seen as acceptable will depend on frameworks applied in risk governance processes and may be subject to controversy between stakeholders. Individual companies and regulators may follow safety standards and regulations within their domains, but accumulated and synergistic risks may not be properly evaluated. Furthermore, attitudes and perceptions about risk in host communities may trigger conflicts regarding the siting or continuance of activities or plans for new activities. This paper addresses issues and conflicts that arise when a company's existing or intended activity causes concerns in its host community about risks, impacts and their consequences for the safety of workers, public health and the local environment. Our research question is how this concerns can be addressed, risk can be managed and conflicts avoided when the risk governance system fosters company engagement with its workforce as well as with the local community in a collaborative effort to address the risks and its impacts. The analytical framework and perspectives combine an enhanced state-managed regulatory process enforcing safety management fitting together with locally negotiated social contracts where local knowledge, transparency, information sharing, citizen participation and multi-agency coordination are important elements. The empirical basis for the analysis is comprised of three case studies including industrial areas, logistic hubs and a chemical refinery involving storage and transport of gas, chemical products and dangerous goods close to urban and populated areas. The first case is an LNG plant with storage and distribution facilities located close to a ferry terminal near the city of Stavanger, the second is a multiple-facility industrial area in Oslo Harbor nearby the parallel expansion of a major "Fjord City Project" with housing, cultural institutions, recreation, etc. The empirical basis for the third case involves a Chevron petroleum refinery in Richmond, California, for which negotiations between Chevron, the community and several groups have been a means to reach agreements over the balancing of impacts and benefits. This "negotiation model" that would supplement existing regulatory frameworks provides for direct engagement between a company, workers, citizens or community and their collaboration in negotiating the actions to be taken to reduce the risks and impacts of concern to the community, reaching agreement, and then implementing the agreed-upon actions. This is followed by analysis of experience in negotiating and implementing "good neighbor agreements" and state-authorized "community benefits agreements", the types of specific commitments and compromises made by the companies and communities and groups involved, the causes of breakdown and success, and the derivation of lessons learned about the value and limitations of the negotiation approach. The three case studies are complementary, and the paper analyze and discusses preconditions for implementation of the finding, criteria for implications for company management. Lessons learned from the case studies indicate that the complexity of technical, economic, organizational, and political conditions underline that one cannot characterize risk and develop risk governance processes independently of established



institutional and practical arrangements in the national and local context. A challenge for a risk management strategy towards the local community appears to involve both the conceptual, analytical and practical approaches. Critical factors in framing and directing the approaches are political and regulatory cultures with sufficient internal, as well as governmental capacity to integrate all concerns and issues in such processes. For the Norwegian cases facts and findings are mainly based on document analysis of papers and reports from regulators, and partly observations of some of the activities related to the cases. In the US-case information comes from Governmental reports (OHSA and U.S. Chemical Safety and Hazard Investigation Board) and interviews with key stakeholders within the local community.

# Improving safety through changes in work place culture: a study from the oil and gas industry in Denmark

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**Keywords:** Accident prevention; offshore; cultural changes

## Abstract

**Background:** The Danish offshore industry at the North Sea has a strong tradition of safety and of reducing work related accidents. During the years the Danish offshore industry has improved safety through education of the employees, development of safety management systems with focus on procedures and risk assessment. In attempt to improve safety new policies and practices are continuously developed. A major challenge is to implement new policies into practice; particularly routines, norms and cultural perceptions may be difficult to alter in the process of implementing new policies. This study aims at exploring the implementation process of a new safety mind-set in a Danish oil company and focuses on 1) the contents and methods of the mind-set (program) and 2) how employees adopt the new safety mind-set. The program started in 2011 and is still ongoing. During the years the Danish offshore industry has improved safety through education of the employees, development of safety management systems with focus on procedures and risk assessment. **Data and Methods:** Data originates from one oil and gas company in the Danish sector of the North Sea. Documentary data includes safety programs and newsletters from 2011-14. During the period April – December 2014, we conducted 3 focus interviews with employees/safety representatives and 3 individual interviews with the management. In addition, we participated in and observed communication and interaction at 18 safety meetings. Finally, we arranged 4 workshops with the aim to discuss the content of the safety mind-set, and how it was perceived by employees. The interviews were semi-structure and focused on evaluation of mind-set, the changes in the culture. The interview transcripts, observation notes, and documentary material were analysed by using Nvivo9. The data was coded in open coding and afterwards merged into more general categories. The analytical focus was centred on key contents of the mind-set and perceptions of the mind-set; particularly perceived advantages and disadvantages. **Preliminary results:** All employees and contractors were introduced to the new way of thinking safety. The main aim of the program was to change the attitude to and understanding of safety towards a work place culture characterized by overall well-being and responsibility for each other. Explicitly, the program sought to nourish a culture, where it is common practice to openly discuss and reprove work behaviour that potentially jeopardizes safety. The program contained elements of empowerment, capacity building, involvement and ownership. In that sense, the program acknowledged that employees' perspectives are the key to a successful implementation process. The preliminary results show that the program had some positive effect on the changes in the work place culture. One of the advantages of the program was more focus on employees' well-being and more involvement of employees in discussing safety issues. The employees perceived the programme as positive, particularly since they felt that it respected their everyday work routines, and that their perspectives were taken into account. However, cultural changes take time, and changes in the workforce are a challenge to maintaining the program. In addition, another disadvantage was the lack of resources to follow up on all activities introduced through the program. Moreover, safety representatives addressed that they lacked concrete and systematic tools to promote and improve safety.

# A comparative questionnaire study of Swedish and Danish construction vocational education: addressing person and situation factors

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**Keywords:** Cross-cultural safety research; Construction industry; Vocational education

## Abstract

### Introduction

The construction industry is one of the worst affected sectors regarding occupational accidents; among European construction workers 4.8% reported one or more accidental injuries in 2007 (Eurostat, 2010).

Sweden and Denmark have much in common regarding factors that may be of importance for construction industry organizational culture. Similarities include geographical proximity, language similarities, common historical background, similar social welfare systems, wage equalities and trade unionism (Dyreborg, 2011; Schramm-Nielsen, Lawrence, & Sivesind, 2004). In cross-cultural research, Sweden and Denmark are regularly clustered together with other Scandinavian countries (Hofstede, 1984; House, Hanges, Javidan, Dorfman, & Gupta, 2004; Inglehart & Baker, 2000). In the GLOBE-project (Chhokar, Brodbeck, & House, 2013; House et al., 2004) the culture of the countries of Nordic Europe were described as characterized by high levels of future orientation, gender egalitarianism, institutional collectivism and uncertainty avoidance, as well as low levels of power distance and in-group collectivism.

Regarding Sweden and Denmark as part of the same cultural cluster, one would expect to find similarities also regarding important organizational factors like occupational safety. Surprisingly, Tómasson and colleagues (2011) found that there are 40% more fatal accidents in Denmark. Four times greater accident rate was measured amongst the Danish compared to the Swedish constructions workers on the Öresund Bridge and Tunnel Project (Spangenberg et al., 2003). Spangenberg and colleagues suggest that differences in vocational education in the two countries could be one possible explanation.

The cross-cultural approach to safety research, employed in the SveDan-project, involving Sweden and Denmark, with similarities, but a clear difference in accident rates, offers a possibility to develop the knowledge of phenomena affecting safety outcomes. A comparative approach may illuminate aspects that could help explain the difference in accident outcomes between the two countries, and thus indicate essential preconditions for high occupational safety performance.

In a meta-analysis of occupational safety Christian and colleagues (2009) concluded that situation-related factors, involving safety climate and leadership; and person-related factors, involving personality characteristics and attitudes, predict safety outcomes.

The aim of the study was to investigate if and how Swedish and Danish construction vocational education differ regarding safety related person and situation factors, according to the attending pupils. We hypothesised that students attending Swedish construction vocational education will rate higher mean values on safety related situation and person factors than students attending Danish construction vocational education.

#### Method

##### Participants

A comparative cross-sectional questionnaire study was administered to pupils attending vocational education to become construction workers in Sweden and Denmark. Data were collected in four Swedish (n=604 pupils) and three Danish schools (n=701 pupils).

##### Measurements

Based on theory and previous empirical research a number of safety factors related to person (Organizational Citizenship Behaviour, Competition, Safety self-efficacy, Safety Locus of Control, Safety attitude, Consideration of future consequences, Involvement/Participation, Implicit leadership theories (ILT) and Safety behaviours), and situation (Role conflict and Safety climate), were measured. There were mostly good and a few 'acceptable' reliability scores for the survey scales.

##### Results

The results indicate that there were differences between Swedish and Danish pupils regarding situation- and person-related factors that can influence construction safety performance. The Swedish pupils demonstrated higher means on OCB ( $p<0,01$ ), Safety self-efficacy ( $p<0,05$ ), Consideration of future consequences ( $p<0,01$ ), Involvement/Participation ( $p<0,01$ ), ILT ( $p<0,01$ ), Workplace safety climate ( $p<0,01$ ), Compliance safety behaviour ( $p<0,05$ ), and Participative safety behaviour ( $p<0,01$ ). The Danish pupils demonstrated higher means on External Safety LOC ( $p<0,01$ ) and Role conflict ( $p<0,01$ ). On Safety attitude, Competition and School safety climate no differences were detected.

##### Discussion

The differences identified can contribute to explaining the differences in occupational accidents rates in the Swedish and Danish construction industry, and highlight situation- and person-related factors that can influence safety in the construction industry. The main finding of this study was that the factors most related to safety outcomes also displayed the biggest differences between the countries, i.e. role conflict and workplace safety climate. These factors are both connected to the apprenticeship part of the education, i.e. the working conditions at the future workplace of the pupils. The challenge for Danish construction vocational education may lie in the part of the education related to the apprenticeship.

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# Reducing airborne noise emitted in work places using materials mainly composed of ceramic industry waste

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**Keywords:** ceramic waste; porous concrete; recycled product; sound absorption coefficient; open void ratio

## Abstract

Every day, millions of workers in Europe are exposed to noise in the workplace, and all the risks that entails. In Europe, one in five workers have to raise his voice to be heard it for at least half the time you're working, and 7% have hearing problems related to their work. According to available data, the hearing loss caused by noise is the most common occupational disease in the European Union. Many times, the noise does not have to be too high to cause problems in the workplace; It can interact with other risk factors and increase the danger to which workers are exposed, for example, increasing the risk of accidents to neutralize the acoustic warning signals; interacting with exposure to certain chemicals to multiply the risk of hearing loss; or being a trigger of workplace stress. An appropriate work place design and layout must allow minimize the number of people exposed to noise and the exposure of workers. The noise reduction must be achieved not only through the use of equipment emitting the least possible noise but also by providing places and workers with appropriate elements to minimize noise transmission, both through air and solid structures. Reducing airborne noise emitted by work teams can be achieved, for instance, using noise absorbing materials in the walls of the room. Furthermore, the accumulation of waste and the need for waste management are also becoming more and more pressing. In Europe the amount of wastes in the different production stages of the ceramic industry reaches some 3–7% of its global production meaning millions of tons of calcined lays per year that are just landfilled. With the increasing restrictions on landfills in the European Union area, the cost of deposition will increase and the industries will have to find ways for reusing their wastes. Although the reutilization of ceramic waste has been practiced, the amount of waste reused in that way is still negligible. Hence, the need for its application in other industries is becoming absolutely vital. Construction industry as the end user of almost all the ceramic materials is well posed to solve this environmental problem which is partially its own. The nature of construction industry, especially the concrete industry, is such that ceramic wastes can be used safely with no need for dramatic change in production and application process. The scope of this investigation is to develop a new sound absorbing material mainly composed (80 % p/p) of CW that can be applied as part of noise reducing devices with te aim to in order to reduce accidents and diseases due to exposure to noise The characterization has been carried out by measuring the sound absorbing (sound absorption coefficient at normal incidence by using a Kundt tube), physical (open void ratio and density) and mechanical (compressive strength) properties of the recycled product. Additionally, since the noise absorption is strongly related to the open porosity of the product, the influence of the particle grain size of CW on the properties of the final product has been analysed, as well as the influence of the specimen thickness on the acoustic absorption. The results have been compared to a porous concrete made of crushed granite aggregate as a reference commercial

material used in similar applications. According to the results obtained, compositions with coarse particles showed greater sound absorption than compositions made with finer particles, besides presenting similar sound absorption, or even better, to the porous concrete used for the same application. On the other hand, the open void ratio tended to increase as the particle size become larger, and the opposite tendency was observed with the density. Since the internal structure becomes more porous when coarse particles are used, the compressive strength of the recycled product tends to decrease. The sound absorbing product showed lower density and compressive strength than the porous concrete which it was compared to. Thereby, CW can be potentially recycled by developing a new sound absorbing material with similar results to other products traditionally used in similar applications. Besides that, the thickness of the final product can be selected in order to reach the best sound absorption at the required frequencies that characterise the specific noise.

# New risk assessment approach for olive oil mills

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**Keywords:** Occupational Accidents; Olive Oil Mills; Risk assessment; Risk decisions

## Abstract

Risk assessment is an essential and systematic process for assessing the impact, occurrence and consequences of specific activities in safety and health. It constitutes a needful tool to support the decisions about risk and, as it can be expected, it is a critical phase to the overall process of risk management in any organization. In view of this, adequate risk assessment tools, which can be able to provide a risk judgment based on a complete and transparent risk evaluation, are needed. In the last decade, several efforts have been developed to find a good quality approach to assess the risk of occupational accidents. However, and despite the developed efforts, it is difficult to find a good approach to be applied in small- and medium-sized enterprises (SMEs). In fact, several of the available methods have revealed to be either too complex to manage in SMEs or very time-consuming and requiring a high effort. Furthermore, most of the SMEs lack the necessary information on accidents history to accomplish for an objective approach. For that reason, in Spain, it is recommended the use of a simplified method based on a risk matrix. This is a qualitative risk assessment methodology similar to the one proposed at BS 8800:2004. However, this kind of methods can be dependent of the OSH practitioners' judgment. In order to overcome these limitations, new semi-quantitative approaches based on the use of public statistics has been proposed. Through these approaches, all hazards that had been materialized in accidents are considered when a task is evaluated and the process of risk assessment takes into consideration the frequency and severity of accidents, being developed in a semi-quantitative way. Thereby, the limitation of the absence of statistical accident data can be surpassed. This is particularly interesting in industrial sectors, such as the Olive Oil Mill (OOM) sector. This sector is one of the most important activity sectors in Spain, particularly in the region of Andalusia. This is also a sector where the risk management process is not a straightforward process, as most of the industries presented particularities that make this process difficult to carry out. There are a high percentage of companies that are micro- and small- sized and the number of workers is irregular throughout the year. Statistical data about occupational accidents are not sufficient at the company level to support an objective risk assessment approach. In addition, in most of the companies, the health and safety management system is undertaken by an external prevention service, which does not have time enough to develop an appropriate risk assessment process. Even so, a proper risk assessment needs to be developed in order to provide supportive information to the companies' managers about the need of risk reduction measures and adjusted to the companies' reality. In view of this, this study aims to develop a semi-quantitative risk assessment tool adapted to the OOM sector reality and that allows using real accident data. The semi-quantitative methodology was developed based on the current distribution of accident mechanisms in each of the tasks. Accident reports for the Manufacture of vegetable and animal oils and fats sector (Code 10.4 of the Classification of Economic Activities) were used in this survey. Data was analyzed in order to identify the set of variables that better characterize the circumstances of an accident in this sector. After that, the acceptance criteria to be included in the risk metric were defined based on the injury distribution, as well as, on the judgment about risk acceptance level of OSH practitioners. The questionnaire previously proposed by Rodrigues et al. (unpublished) named "Risk Acceptance in the Furniture industrial sector" (ARAF) was adapted to analyze the judgments of OSH practitioners about the risk acceptance level in OOM. An adjustment to the scales included in risk scenarios of the ARAF was done considering the accident distribution of the Olive Oil Mills in Spain. To define the risk acceptance limits, adjustments to the accident distribution were made in order to approximate it to the OSH practitioners' acceptance levels. At the end, a risk matrix was defined, where an estimate of the probability of occurrence was obtained by considering the frequency of accidents and the severity (established by the corresponding lost workdays). The acceptance



criteria developed were integrated into the defined risk matrix. The final methodology allows the prioritization of the risk within three different categories: low, moderate and high. The developed approach is seen as a good strategy to reduce the subjectivity of the risk assessment and to ensure a prioritization of risk measures, identifying the most critical situations. Additionally, it has the advantage of including specific acceptance criteria for OOM, defined according to the reality of the sector and the stakeholders' judgments.

# Learning from successful operations – opportunities, challenges and a paradox

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**Keywords:** safety; learning; successful operations

## Abstract

A rich array of methods exists to analyse the causes of accidents and critical events, and a great effort is put into such analysis and dissemination of results by the industries and national authorities world-wide. There is, in contrast, a scarcity of methods for analysing successful operations. The project "Learning from successful operations" was initiated to correct some of this shortcoming. The objectives of the project are to provide (1) new scientific approaches to study successful operations, (2) documentation of cases of successful operations that can be used for educational purposes and meta-analysis, (3) new theoretical accounts of successful operations, and (4) methods and guidelines that can be used by companies to analyse and learn from successful operations (e.g. in incident investigations and safety audits). "Success" and "successful" here refers to the safety aspects of an operation. The paper will summarise insights that we have reached at an intermediate stage of the project related to the following issues: 1. To what extent can implications for learning from successful operations be derived from current organisational theories of safety? 2. How can learning from successful operations take place in practice? 3. What are the challenges related to learning from successful operations? The paper is based on a selective literature study, document studies, qualitative interviews with personnel in two drilling companies, initial observations at a drilling simulator and from a workshop in a petroleum company operating on the Norwegian continental shelf. It is possible to derive a broad array of theoretical tools to account for successful operations from current organisational theories of safety. This will be summarised in the full paper. It is, however, more difficult to derive criteria that distinguish successful from less successful operations, apart from absence of adverse outcomes. Alternative criteria for identifying successful operations will be discussed in the full paper. Learning from successful operations can take place either through informal mechanisms or through mechanisms deliberately put in place by management. Informal mechanisms range from tacit experimentation and adaptation at the individual level ("reflection-in-action") to informal reflection and coordination at the level of work groups ("reflection-on-action"). More formal mechanisms include reporting systems, debrief sessions in simulators and the real world, and workshops. Companies may also recruit persons they consider successful for critical or difficult tasks, based on the assumption that these persons will repeat their success. We have identified several challenges related to learning from successful operations: 1. Characterising an operation as successful may be problematic, since the absence of adverse outcomes does not necessarily imply that the risk was well controlled. There is thus a need for alternative criteria or approaches to distinguishing between successful and less successful operations. 2. It is easy to get captured by "the official version" or "work as imagined" when describing a successful operation and explaining the success. Those aspects of successful performance that are not included in "the official version" may remain tacit, either because people are not aware of them, or because they lack the language for expressing them, or because they may fear sanctions for deviating from "the official version" as prescribed in rules and procedures. As a consequence, learning processes may maintain current dogma and practices rather than trigger new insight and improvements. 3. Successful operations rarely lend themselves to rigorous approaches for establishing causal connections between how operations are performed and the degree of success, such as true experimental designs. 4. Strategies that contribute to successful operations in one class of sociotechnical systems may prove detrimental in sociotechnical systems with other properties. For instance, success in some systems depends on rapid and decisive interventions, whereas

other systems call for careful deliberation before actions are taken (Schulman, 1993). Paradoxically, whereas learning from successful operations has received limited attention in the safety science literature, learning from operations that are perceived to be successful appears to take place all the time in the real world. However, the outcome of such learning is not always improved safety. As illustrated by Vaughan's (1996) notion of "cultures of deviance" and Snook's (2000) notion of "practical drift", learning from episodes that are perceived or labelled as successful may, over time, contribute to drift into failure. Learning from successful operations thus concerns not only securing and promoting the positive lessons that may be learned. It is also a matter of containing processes that may lead to drift into failure. References: Schulman, P. (1993). The analysis of High Reliability Organizations: A comparative framework. In: Roberts, K.H. (ed.). *New Challenges to Understanding Organisations*. New York: Macmillan. Snook, S.A. (2000). *The Accidental Shootdown of U.S. Black Hawks over Northern Iraq*. Princeton, NJ: Princeton University Press. Vaughan, D. (1996). *The Challenger Launch Decision*. Chicago: The University of Chicago Press.

# Standardization in the field of nanoparticles

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**Keywords:** Nanoparticles; personal protective equipment; skin protection; standardized tests; respiratory protection standard

## Abstract

The development of technology based on nanomaterials has led to the emergence of new risks associated with working with nanoparticles, with consequences for the safety and health of workers hitherto unknown. Because of this and the rise in its use, nanotechnology and the use of nanomaterials have been classified as an emerging risk within the European Union (EU). Given this situation, the need to regulate working with nanoparticles is arising recently. It is necessary to have standards incorporating best practices and other recommendations to protect the safety and health of workers handling these materials. Within these practices and recommendations, individual risk protection (personal protective equipment or PPE) is especially relevant, because although it is the last of the preventive measures that should be implemented (after elimination of risk, control in the origin and collective protection), the ease of implementation of PPE makes them widely applied in the workplace. Regarding accident prevention it is vital to know the efficiency of PPE against nanoparticles because if we are not certain of their degree of protection, we can not ensure that they avoid damage to the health of workers. And the compliance of certain standard tests should be verified to manufacture successfully PPE with known protection levels. The effectiveness in protecting using PPE is linked to the selection of an appropriate equipment and proper fit, use and maintenance. Regarding the selection, protective equipment must comply with European standards of manufacturing and marketing (CE marking of conformity) or any other mandatory standards from a place outside the EU. However, compliance with these standards does not guarantee user protection in any situation. In fact, the protection offered by certain PPE during exposure to nanomaterials is a matter of debate and study nowadays. The question is whether there are specific PPE whose effective protection against nanoparticles has been demonstrated. Unfortunately there is not an affirmative answer yet. Beginning with the skin protection and focusing on clothing and gloves, currently existing standards collect various tests to determine the resistance of PPE against the permeation of chemicals, penetration of liquid and spray, penetration of solid particles, leakage to the interior, and material degradation, and there are certain parallels and similarities between the standard tests at European level and internationally (American Society for Testing and Materials, ASTM). In relation to the means of respiratory protection (masks, half masks, and filters), the tests contained in the existing standards focus on the evaluation of three parameters: the penetration of particles through the filter; the inward leakage (facial leakage through the contact surface of the facepiece to the face); and clogging of the filter. Again there is similarity in trials at European and American level (proposed for equipment certification by NIOSH, National Institute for Occupational Safety and Health). But these tests were designed to particle sizes or aerosols of the order of millimeters or microns, in some cases hundreds of nanometers, but not for sizes of the order of units or tens of nanometers. Therefore, there are currently no published standards developed specifically to check levels of PPE protection against nanomaterials. However, there is wide work in the field

of research and experimentation, which allows the extraction of valuable conclusions and practical recommendations. These papers guide the way forward to further progress in understanding the nature of the risks associated with nanomaterials and nanoparticles and in the control of these risks. Research and experimentation in the field of skin protection shows that the conditions for conducting the tests should simulate actual conditions of use clothing and gloves instead of "copying" the conditions of forced flow testing of respiratory material, because the latter conditions lead to a result distorted by excess. In turn, the influence of the type of material is tested by the evaluation of parameters such as fiber diameter, number of pores and their size and volume, air permeability and thickness of the material. The development of standards for protective clothing is entrusted to the Working Groups of the Technical Committee 162 of the European Committee for Standardization. Currently these groups work on the line to define requirements and tests applicable to a new type of protective clothing that covers the risk exposure to nanoparticles. The preliminary ideas are based on adapting clothes to certain tests coming from the field of respiratory protection. Regarding respiratory protection, trials of penetration through the filter show a great variation in the effectiveness according to the particle size, and a maximum penetration size is detected (MPPS: "Most Penetrating Particle Size"). Other aspects that have been evaluated are the influence of flow, the type of mask and the inward leakage factor. It is noteworthy that, unlike what happens with protective clothing, standardization committees for respiratory protection are not considering drafting rules for specific assay for nanoparticles. Despite everything said, there are specific standards engaged to nanotechnologies (technical report the case of the European standard). These standards follow the scheme presented in these lines: collecting results of research and experimentation to date of publication, as well as recommendations for risk management in the workplace. Therefore, these documents also fail to set standardized tests to ensure levels of protection for risk control measures. This is a task that must be performed.

# **Safety climate considerations in the development of a management system for safety, environment, and process control in engineering laboratories at the National University of Ireland, Galway.**

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**Keywords:** Laboratory Safety; Safety Management; Environmental management; Safety Climate Questionnaire

## **Abstract**

The College of Engineering and Informatics of NUI, Galway has recently moved into its new engineering building. Management wishes to improve the state of health, safety and quality issues within the College laboratories. For that reason a bona fide laboratory safety management system was required. This project firstly surveyed the attitudes to health and safety levels within engineering laboratories by conducting a safety climate questionnaire and interviews and developed a laboratory safety checklist. The safety climate questionnaire was adapted from one that was created by a joint industry and UK Health and Safety Executive research project on the assessment of safety culture in offshore environments (HSE, 1999). Our research also resulted in the development of the checklist mentioned above, and a standard operating procedure template that also focuses on environment and process procedure and recommendations to create databases of equipment, chemicals, vaccinations and safety training. All of these if taken together will give management the information they need to bring the safety, process procedures and environment to an acceptable level within the College. Recent audits of the engineering laboratories which included an inspection of over five hundred pieces of equipment and the risk assessment of over ninety pieces of equipment have raised concerns with respect to housekeeping, maintenance, risk assessment, Standard Operating Procedures (SOPs), and the use of personal protective equipment (PPE), (Broggy and Gaffey, 2008). This has led management to see the need for a practical and bona fide Laboratory Safety Management System (LSMS). Such a system would incorporate documented operations, demanding record keeping, and regular quality and safety audits. This task was a challenge due to very specific nature of laboratory work itself and diversity among the laboratories within the College. For example in the environmental engineering laboratory work is conducted involving mainly chemicals and biologically contaminated samples whereas in the mechanical engineering laboratories there would be many large machines posing mainly mechanical hazards. Because of the fact that the labs are staffed by professionals it is necessary to accept this fact, but introducing order and safety rules is of foremost importance. Before the work on the development of the LSMS could start the identification of what is a good and standard practice in terms of laboratory work had to be made. For that reason an extensive literature review was conducted on this topic. The first step in the development of a LSMS is to understand the organisation and its culture. In this study it was decided to conduct a questionnaire survey of the two groups working in laboratories: technical staff and research staff. The questionnaire used was a tool prepared by the Health and Safety Executive (HSE) in the UK in conjunction with the oil industry. The next step in the process was to develop a safety management system that could be used for all the laboratories within the College collectively. This task involved the development of a Standard Operating Procedure (SOP) template and testing it on a number of procedures and pieces of equipment, and the development of a central database containing an inventory of equipment and chemicals, records of risk assessments, maintenance and service, portable appliance testing, training, accidents and near misses reports. Finally, the last step involved issuing recommendations to the College's management for the implementation of a Laboratory Management System.

# Psychological safety climate and professional drivers' wellbeing. The mediating role of time pressure

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**Keywords:** Organizational support climate; Organizational safety climate; Organizational time pressure; cross-level study

## Abstract

Organizational time pressure appears to be a relevant stressor among professional drivers, where "just-in-time" management could result in employees working to tight deadlines. This study addresses its impact on professional drivers' satisfaction with organizational safety, sickness absence, and physical and mental fatigue symptoms. This relationship is expected to be mediated by organizational safety climate (Hypotheses 1). Additionally, this study postulates that organizational support climate would buffer the negative relationships between organizational time pressure and its negative correlates (Hypotheses 2). Organizational time pressure may be detrimental for safety climate by means of affecting organizational safety policies and practices implementation: employees may shift their focus from safety to productivity which may be perceived as most likely to be rewarded under pressure (e. g., adoption of shortcuts to get the job done). Organizational support climate would buffer the negative effect of organizational time pressure on safety climate. Job demands-control (-support) (JD-C) and job demands-resources model (JDR) support the buffering role of social support. Job demands-resources model (JDR) establishes that resources such as organizational support climate may alleviate the potential negative effects of job demands by means of either providing instrumental support or protecting employees from impaired health. This study was carried out in a sample of 367 employees (drivers) from 34 Spanish road transport organizations (a survey was administrated). Eighty-seven per cent of drivers were male. Sixty per cent were between 35 and 55 years of age, 51.7% had completed primary education and had previous experience in the road sector (56.5%). Most organizations were small organizations (less than 25 employees) (41.4%) or medium organizations (less than 250 employees) (44.8%). Only 13.8% were large ones (more than 250 employees). Fifty-nine per cent of the organizations were dedicated to the transportation of goods and 41% to passenger transportation. Our data set comprised data at the organizational level (Level 2; organizational time pressure, and organizational support and safety climates) and at the individual level (Level 1; organizational tenure, tenure in the transport sector, individual job satisfaction with safety, fatigue symptoms and sickness absence). In order to test Hypotheses 1, we followed a hierarchical data strategy and examined a number of nested models using Hierarchical Linear Modelling (HLM). The moderating hypothesis at organizational level (Hypotheses 2) was tested by a hierarchical multiple regression analysis. Results showed that organizational safety climate mediated the cross-level relationship between organizational time pressure and individual satisfaction with organizational safety and health (sickness absence and physical and mental fatigue symptoms). Organizational support climate moderated the relationship between organizational time pressure and safety climate. In high organizational support climate conditions, the slope of the relationship was not significant. Conversely, in low organizational support climate conditions, the slope was significant. That is, when organizational support climate is high, the influence of organizational time pressure on the level of safety climate disappears. Findings on the mediating role of organizational safety climate in the relationship between organizational time pressure and individuals' health and satisfaction with safety have relevant practical implications for professional drivers, who have high risk of poor health and road accidents involvement. Additionally, research on the antecedents of safety climate and their interrelationships, extends previous research and provide insight on how to promote safety climate.

# **The contribution of accident analysis, from the perspective of ergonomics, in the management of safety and health at work: a case study in a power company**

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**Keywords:** Accidents. Analysis models. Management

## **Abstract**

Organizations use, as an important tool in their management processes, the implementation of certifiable management system, which in issues of health and safety at work is accomplished by the so called OHSAS 18.001. This international management system specification is structured in the form of the PDCA cycle, which includes in the management process the actions of planning, implementation and operation, checking and correcting to finally analyze it critically in order to, periodically, make up the necessary adjustments and ensure continuous improvement. It is at the stage of verification and corrective action that investigation and analysis of accidents has a key role, since accident is the most significant non-compliance to OSH management and the manner of accidents are handled reveals the way an organization understands and treats the problem. The aim of this study is to investigate which models available in literature are used for accident analysis in a power company in order to verify its ability to identify the causes and to propose corrective actions. This research has an exploratory and qualitative approach and analyzes data from internal documents, participant and non-participant observation, always from the perspective of ergonomics, available for the period between 2007 and 2011. This approach and data allowed a more in-depth analysis on the topic. The results of this research showed that most of the accident reports studied have characteristics of the sequential and epidemiological models and, overwhelmingly, keep the limited view that the fundamental cause of accidents are unsafe acts or human error so that the preventive vision focuses on preventive human action and this view compromises the improvement of the OSH management performance.



# Safety climate and job demand-control-support: impact on health and safety practitioners' wellbeing and efficacy

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**Keywords:** safety climate; Job demands - control - support; health and safety practitioner; work efficacy; health and wellbeing

## Abstract

**Background/Aims:** Health and Safety Practitioners (HSPs), as frontline professionals advocating for the health and safety conditions at work, have a pivotal role in the wellbeing of employees. Safety climate (SC) has also been recognised as an important element for the occupational health and safety (OHS) of an organisation and its workers. This concept is understood as the shared perceptions of individuals on the true priority of safety in the workplace and it is known to have an impact on safety outcomes, safety performance and safety behaviour. Having a safety manager (or higher ranking safety practitioners) on site has been found to result in a higher safety climate. Studies have also demonstrated that SC affects the level of psychosocial strain experienced by professionals. Hence, SC will not only affect the HSP task of ensuring workers' wellbeing at work but, as professionals themselves, this concept will also affect their wellbeing. Research has shown that diverse issues related to demands, control and social support affect individuals at work (Karasek's model). Particularly, it is now known that these psychosocial issues, in addition to role definition, have a great effect on the HSPs. Hence, both the concept of safety climate and Karasek's Job Demand-Control-Support model seem to be influential for these professionals. The current study aims to explore the possible impact of an organisation's SC on the health and wellbeing of the HSP and their work efficacy. The contribution of job demands, control and support are also explored as factors contributing to the aforementioned association and as elements which may also directly affect the wellbeing and efficacy of the HSPs.

**Methods:** A web survey was distributed to approximately 9,000 HSPs, members of the Institution of Occupational Safety and Health (IOSH) in Ireland and UK. A total of 1444 completed questionnaires were yielding a 3.70% response rate. Zohar and Luria's (2005) scale was applied to assess organisational safety climate. Job demands, control and support were measured through the items from Karasek's Job Content Questionnaire (2004, 1979). Hierarchical multiple regression was used to study the contribution of each independent variable (SC) and covariates (Job demands, control and support) to the dependent variable (General health – assessed with GHQ12; and mental wellbeing – measured with the Warwick and Edinburgh Mental Wellbeing Scale). Work efficacy was also used as a depended variable and it was assessed with items from competence and impact from the Empowerment Tool by Spreitzer (1995 in Wilson et al., 2004).

**Results:** Although Safety Climate levels in the participants' organisations were positive, a high level of job strain was noticed in the sample. Respondents showed good levels of health, wellbeing and job efficacy. However, there was a high level of job demands, low job control and low support in the sample. Significant associations were found between SC, Job Strain, Control, Demands, Control and GHQ12 scores, mental wellbeing and job efficacy. After adjusting for age, gender and years of experience, safety climate was significantly associated with general health ( $\beta = -.17$ ;  $p < 0.01$ ), mental wellbeing ( $\beta = 0.25$ ;  $p < 0.01$ ), and work efficacy ( $\beta = 0.18$ ;  $p < 0.01$ ). Health climate and psychosocial work factors were also associated with all three outcomes. JDSC showed a significant contribution to the association of SC and HC with GHQ12 scores and wellbeing levels. A consistent and substantial attenuation of the coefficients was observed for HC and SC and each of the three studied outcomes when entering demands, control and support into the respective models.

**Conclusion:** These findings highlight the impact of SC on the wellbeing of the professionals responsible for the health and safety of organisations. The results also show the importance of SC to the work efficacy of the HSP, demonstrating, therefore a further consequence that safety climate can have on the organisation's safety performance. This study was also able to demonstrate a clear link between SC and Karasek's model of job demand-control-support,

which had been rarely recorded previously. The current results allowed understanding of the main psychosocial pressures affecting the health & safety professionals and the main organisational challenges faced by these individuals. These circumstances can, consequently, affect further workers and stakeholders within the organisations. It is important to address the issues of increased job demands for the HSPs in the UK and Ireland and the lack of job support and control. Only then will it be possible to allow these practitioners to operate at a possibly optimal level, contributing to the maintenance of the best health and safety working conditions of their organisation's workforce and the best safety performance.

# Safety observations at Danish and Swedish carpentry schools

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**Keywords:** safety behaviour; safety conditions; safety education; personal protective equipment; safety index

## Abstract

Introduction Data from national working environment authorities reveal a higher rate of reported occupational accidents in Denmark than in Sweden. A previous study found that Danish construction workers had an over four fold greater risk of injury than Swedish construction workers – while working alongside each other on the same project task! The large difference in accident rates is surprising, as Sweden and Denmark have relatively similar cultural and historical backgrounds. As part of a research project aimed at identifying national, organisational and individual factors that may contribute to explaining the current difference in risk of injuries in the construction industry between the two countries (The SveDan project), we hypothesised that safety is given higher priority in Swedish Vocational Education and Training (VET) programs compared to the Danish programs. One way of studying this was to measure the observable level of safety in the Swedish and Danish VET programs. The carpenter VET program was chosen as it is more similar in Sweden and Denmark than for other construction professions. We test the (alternative) hypothesis that the observable level of safety is higher in Swedish carpentry school workshops than in Danish carpentry school workshops. Methods Three Swedish and three Danish carpentry schools were strategically selected to represent large and smaller schools, and to be located in a major city, as well as in smaller urban communities. Among schools fulfilling these criteria selection was by convenience. The schools that were approached all accepted participation. A Finnish inspired safety observation method was pilot tested and applied. Safety topics, e.g. wearing safety shoes, were observed and recorded as either 'correct' or 'incorrect', depending on whether they met the safety requirements (national and/or additional school safety standards). A safety index of an observation round was expressed as a percentage of the correct safety observations (numerator) out of all safety observations (denominator). Three rounds of safety observations with approximately 150 observations per round were carried out at each of the six schools, with at least one week's interval between observations over the three-month period of November 2014 to January 2015. A list of 13 safety topics were grouped into three themes: 1) Safe working conditions in the workshop (order and tidiness, access ways, guardrails and stairs); 2) Use of appropriate and relevant personal protective safety equipment (safety shoes, safety glasses, hearing protection - own and for others close by, respiratory protection – dust mask, fall safety equipment); and 3) Safety behaviour (proper use of ladders, screw clamps - to secure wood when e.g. sawing or chiselling, machine saw blade protection, use of wood dust extraction system, as well as teacher behaviour when instructing and working). The overall safety indexes and safety indexes for each theme between countries and within each country are analysed as incident rate ratios using a generalized linear model and Poisson distribution. The probability of statistically significant differences between the safety indexes are calculated using Fisher's exact test (two-sided). Results A total of 3,654 topical observations were made at the six schools during the three rounds (Sweden 45% of observations, Denmark 55 %). Analyses

reveal a non-significant 0.4 % (factor 1.004) difference between the overall safety index in Sweden and Denmark. However, there are significant differences between the three schools within each country. Two of the Swedish schools have a significant 5 % and 6 % higher overall safety index than the third Swedish school. In Denmark, one of the schools has a significant 7.5 % and 6.6 % higher overall safety index than the two other Danish schools. Similar results are found when analysing the safety indexes for the three safety observation themes. There is less than a 0.3 % difference for each of the three themes between countries, whereas there are significant differences between schools for the three themes within each country. When looking at the theme 'Safe working conditions' two of the Swedish schools have significantly higher indexes (10 % and 11% respectively) compared to the third Swedish school. However, the third Swedish school has a higher (though non-significant) safety index than the other two Swedish schools for the two themes 'Safety equipment' and 'Safe behaviour'. In Denmark, school 1 and 2 have significantly higher indexes (7 %) for 'Safe working conditions' compared to school no. 3, whereas school no. 1 and 3 have significant 18 % and 12 % higher indexes for 'Safety equipment', and school no. 1 has a significantly 16 % higher index for 'Safe behaviour' than the other two Danish schools. Discussion No significant differences are found in the observable level of safety between carpentry schools in the two countries, whereas there are significant differences between the schools within each country both overall and for the three individual safety observation themes. The national difference in accident rates do not appear to be explained by differences in the observable level of safety in the trade schools. These results will later be validated with interview and survey data from the schools as part of the SveDan project. In addition, the observable levels of safety at Swedish and Danish construction sites will be compared in an upcoming part of the project in the fall of 2015.

# The importance of communication for the maintenance of health and safety in work operations in ports

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**Keywords:** health; safety; port worker; communication

## Abstract

**Introduction:** The work of transport and handling of goods at the port is collectively executed and so it requires good coordination among workers to deal with the usual and unexpected situations of daily work (Dejours, 1993). Communication is fundamental so that they can cope with the variability of work, that is, communication is a component of the activity (Silva, Brito and Athayde, 2004) and are used to plan, monitor, modify, coordinate, negotiate, discuss, evaluate the practical action thus serves to guide the useful knowledge for the actions (Navarro, 1993). The strong ties built in the work in ports have a very peculiar culture. Thus, the body language as well as the oral are important components of maintaining health and safety at work. In many situations, the workers point out the importance of communication for ensuring safety at work, which happens to be in their own hands, supported by bonding activities (Queiroz, Moreira and Dalbello-Araújo, 2012). There are collective construction reports and important partnerships for the implementation of activities, and several indicatives insinuate the necessary familiarity with the universe of the port for the effectiveness of the various activities in the sector (Queiroz, Moreira and Dalbello-Araújo, 2012). **Objective:** To analyze how communication take place between port workers and their importance for the preservation of health and safety for operators. **Methodology:** The research is the result of a case study conducted in a port located north of Portugal, where the movement of goods, representing 25% of Portuguese external trade by sea. This port is responsible for transporting various types of loads, such as wood chips, scrap, glass meal, wind parts, verguinha, metal rollers, stone, wheat flour, containers and vehicles. The research included dock workers of a private company, providing services in the container terminal and general cargo terminal. It involved systematic observations of work activity on the pier and boats, completed with semi-structured interviews and individual and collective refunds. Individual and collective refunds served to deepen some aspects identified during observations, fundamental to the knowledge of subjective experiences of these workers. **Results and Discussion:** During the investigation each port worker was observed not as an isolated individual but inserted into working relations with other port workers, who perform other functions, such as boarding, stevedores, inspectors, crane operators, among others. These interactions among workers take place through various forms of communication: gestures, movements, looks, facial expressions, verbal or printed information, operative codes. In the observations was possible to register some forms of communication that does not necessarily passed through oral communication between team members (whether by the distance between the elements, either by noise of the machines working on the docks and in the cellars). Thus, there was the use of horn, in the examples of situations: 1) the port worker uses horn to inform traffic workers (ground) when there are locked containers preventing the landing. These, in turn, point to the crew (on board) through gestures and shouts, which immediately unlock the said container. 2) in bulk flour landing, crane operator uses a crane to transfer the ship's cargo to a huge funnel, in soil, where it is deposited in trucks. The traffic worker regulates the load to be placed in each truck using a horn to inform the driver of the truck when it has to move forward or when he has to leave if the load is already complete. However, if the horn is broken he hits a piece of iron to make himself understood. The use of gestures with upper limbs and hands (every gesture has a meaning) in the examples: 1) the gangway, when performing its function, for example the transport of verguinha, uses radio communication, but also gestures and movements to inform the crane operator to tell where to deposit the load or when interrupting the operation (fist arms or bent arms forming a cross) respecting the planning of the ship's officer and the safety of colleagues in the hold of the vessel, as stevedores. 2) in the transport of containers, the gangway, working on the ground or boarding the ship, according to the need and gestures tells the portico of the workers when they need to pick up or deposit any local load that does not allow its view, so gangway acts as the eyes of the crane operator. In this case,

boarding gestures might include: fist up and down means container with merchandise; flat hand up and down is indicative of empty container. The use of oral communication, in the example of the situation: 1) to move enormous wind machine parts in the basement of the vessel the coordinator does not see the stevedore (the other side) and has to rely on verbal information provided by the same, during the placement of braces which will then be hauled back out of the vessel by the crane worker. Conclusions: performing work activity involves the introduction of different ways to communicate and it is essential to rely on the information that is received and that is sent out. The impact of these communications is visible at several levels: the possibility of meeting deadlines; the quality of their work; and also for the safety of all those involved in work situations. There are variations in communication according to the type of load to be carried, but also according to the function of each team member. Communication related to security issues are closely related to working communication, no safety behaviors may be considered distinct from work behaviors.

# Environmental and working conditions in sea cargo: how to make safety shout instead of whisper when money talks?

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**Keywords:** Maritime industry; Working conditions; Regulation; Environmental conditions; Discretionary space

## Abstract

Crews' working conditions are very different across the branches in the maritime industry. Earlier maritime studies have shown that the unequal amounts of public attention determines how much safety resources a branch get (Lindøe, Engen, & Olsen, 2011) and that cargo rate indicates accident frequency (Soma, 2004). Maritime safety regulation development is paralyzed due to the global transport competition, costumers' and industry's propensity to profit and the political fear of out-flagging, so safety is left to the market forces (Størkersen, 2015).

Such external conditions influence the socio-technical levels involved in hazardous processes (Rasmussen, 1997). Actors in government, regulators, researchers, companies etc. state that environmental conditions are important for safety and working environment, because they influence how organizations, groups or individuals can control risks of accidents (Rosness, Blakstad, Forseth, Dahle, & Wiig, 2012, p. 807). Production priorities tend to trump protection and safety in daily work or business decisions (Hollnagel, 2009; Reason, 1997). Working conditions are suggested to be constituted by the degree of facilitation and discretionary space (Størkersen, work in progress).

In this paper I explore the relation between working conditions and environmental conditions in the various parts of the cargo industry branch, where the working conditions are highly diverse. The analysis is based on observation and interview data from the crews on 14 vessels from various parts of the cargo branches, in addition to reported survey data from the same vessels and other ship owner-companies in the same period (Fagerholt, Kongsvik, & Størkersen, 2014; Størkersen, Bye, & Røyrvik, 2011). The vessels are owned by Norwegian organizations, but registered both in Norway and several flags of convenience.

This study's contribution to the research field is an empirical analysis of and discussion about how environmental conditions influence the facilitation and discretionary space to work safe on each level – finding also that the external factors of Rasmussen (1997) affect the working conditions more than the socio-technical levels. The data material is limited and cannot generalize behalf of the different cargo branches, but contours of some patterns arise.

Market powers constitute the most dominant environmental condition in the descriptions from the cargo crews. Profit and competition in their industry branch is essential for the facilitation and discretionary space they get. However, regulation seems to be potentially even more important because it can set standards for how companies should facilitate for safe working conditions. Yet, the flags of convenience do not lift the working condition standards, and also Norwegian regulation let market powers provide the premises. The discussion indicates that only public behavior can change regulation towards more safety impact. If people want safety, they must choose it: The Marxist fight for power is turned – the people are the costumers and the voters and society reflects our values – so we must use our powers if we want safe industries. In practice, money talks!

As the situation is, the cargo vessel's assigning organizations control most of the environmental conditions. The result is cost reductions and fewer resources for safety, as safety measures are expensive and therefore a competitive drawback. Instead (preparing for people to be willing to pay for safety), the assigning organizations could make safety a criterion in tender processes, thus making safe working conditions a competitive advantage.

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# Identifying and monitoring proactive, human factor oriented safety indicators

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## Abstract

**Project background** The information basis for decisions related to safety is often quite vague. The difficulty to assess a system's safety as well as to assess the effectiveness of safety-related measures are two of the main reasons for this vagueness. These difficulties are due to a multiplicity of contributing factors, a lack of knowledge regarding their complex interrelations, and a lack of methods for objective, reliable, and valid measurement of these factors. However, in order to proactively mitigate risks or to provide resilient processes able to cope with safety threats a more reliable information basis would be very helpful. At the start of the project current practices in safety assessment and safety decision-making were analyzed and evaluated in two in-depth case studies at the sites of two partners operating in high-risk industries (aviation and nuclear power production). Interviews, observations, and analysis of documents were applied to collect empirical evidence. The case studies mainly reveal the following critical aspects.

**Indicators and measurement:**

- The set of measured indicators includes reactive indicators rather than proactive indicators, and hence safety outcomes rather than safety enablers.
- Indicators not referring to hard, countable facts are measured rather in an ad-hoc manner, than by applying state of the art (social science based) methods for data collection and analysis.

**Aggregation of data, interpretation, and decision-making:**

- Indeed, safety management processes are well systematized, described in a comprehensible way, and responsibilities are assigned clearly. However, aggregation of data, interpretation of information, and decision-making is driven by distributed subjective assumptions regarding cause-effect relations and interactions of different indicators. These subjective assumptions incorporate a lot of tacit knowledge, the quality of which is extremely difficult to assess.
- Decision-making based on tacit knowledge incorporates the risk of cognitive biases (e.g. risky shift, confirmation bias, selective search for evidence, etc.).

**Project objectives** The case studies show that in reality the quality of both, the safety indicators as well as the collected data is often very heterogeneous. Some of the indicators represent "hard factors" and can be quantified very reliably. Others refer to "soft factors" are extremely difficult to operationalize and require at least partly a qualitative assessment. Furthermore, not only measurement is a problem, but also the integration, aggregation and interpretation of the collected data. As a consequence safety assessment runs the problem to rather produce an immense amount of data than an information basis for decision-making in safety management. Against this background the project objective was to develop a process, which systematically supports stakeholders on different organizational levels and in different functions (line as well as safety officers):

- to identify proactive, human factor oriented safety indicators appropriate to assess system safety, considering the organization's specific characteristics,
- to monitor the critical proactive safety indicators referring to both, actual state as well as trends in time series
- to assess and to interpret the information, and
- to prepare well-founded safety related decisions.

**Hierarchical model of proactive, human factor oriented safety indicators** As there is not sufficient exact knowledge regarding what to look for, the S-MIS project adopted a participatory approach relying to a large amount on (tacit) expert knowledge of practitioners. A multidisciplinary project team consisting of both, experienced subject-matter experts from practice as well as researchers are guided through several steps. This process is designed in a way allowing for the integrative consideration of the tacit knowledge the industrial practitioners have with respect to the complex interplay of safety related factors on the one hand, and the conceptual background of the researchers on the other

hand. The result is a hierarchical model of proactive, human factor related indicators representing the organization's specific characteristics. Applying the indicator model for safety assessment and decision-making In order to monitor safety, focus groups are composed within the organization. The members of these focus groups are selected by management decisions. The aim is to include experienced people able to critically reflect the organizational units they are representing. However, in order to avoid cognitive biases process rationality was designed into the process. The focus groups use the proactive, human factor related indicators developed and operationalized as described above to periodically assess the organizational unit they are representing. In a Delphi method like fashion the members of the focus group in a first step individually complete a questionnaire covering the operationalized indicator model. Since the focus groups assess their units periodically, time series data are generated. These data is used to identify trends. In a second step they discuss the results of the questionnaire-based assessment. Doing so, the group collects qualitative arguments for each indicator's rating and trend. Such, measurement is concretized with concrete, real-world based reasoning. Experiences and results of applications in industries will be presented.

# Incorporating age management into company's OSH management

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**Keywords:** OSH management; age management; integrating age management and OSH management

## Abstract

**Background:** Age management is often understood as a collection of HR practices which are implemented in companies with the aim to maintain employees' workability. However, important factors influencing workability are related to the material, psychological and social work environment and are subject of occupational health and safety management. Also, to ensure that actions directed at maintaining workability will be successfully implemented the elements of age management should be incorporated into HR management as well as into OSH management. The main elements of age management which are linked to OSH management include age management policy, management commitment to and workers participation in actions aimed to maintain workability, planning and communication concerning age-related issues, age-sensitive occupational risk management and OSH monitoring which covers psychosocial factors and workers health. **Research methodology:** To identify the level of incorporating age management into companies' OSH management systems, the study has been conducted in 86 companies including 20 small, 35 medium sized and 28 large companies. The total number of people employed in these companies amounted to app. 88 thousands. 42 of the companies had implemented formalised and certified OSH management systems. The questionnaire covered questions related to the level of incorporating age management into different elements of OSH management system. Each element of age management has been assessed on the basis of answers received as not implemented, partly implemented or satisfactorily implemented. **Results:** All the elements of age management – except of health promotion and participation of employees – was evaluated as at least partly implemented in more than 70% of the surveyed companies. One of the most widely implemented element of age management is communication on age-related issues. It has been satisfactory implemented in almost 60% of the surveyed companies and partly implemented in app. 35% of them. The management commitment in age-related issues has been assessed as satisfactory in almost 50% and the participation of employees only in app. 16% of the companies. Among the aspects of age management related to occupational risk management, the highest level of implementation were given to adjusting the scope and frequency of medical investigations according to the age of employees which had been satisfactory implemented in more than 67% of the surveyed companies. Other aspects related to age management, such as considering age aspects in occupational risk assessments and adjusting work or changing workplace equipment taking into account the age of worker has been assessed as satisfactorily implemented in less than 20% of companies and in app. 30% of the companies these aspects had not been implemented at all. Only in app. 40% of the surveyed companies OSH monitoring includes psychological and social factors in work environment. Various aspects of health promotion were implemented partly or satisfactorily in more than 30% of the surveyed companies. OH&S management systems implemented in companies according to different voluntary standards on OSH management (like OHSAS 18001) do not support age management. The survey results indicate that only some companies develop their OSH management systems taken into account the need to incorporate age management in OSH-related actions.

# Using electronic and traditional methods of communication in OSH management

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**Keywords:** OSH management; communication; methods of OSH communication

## Abstract

Background: Electronic methods of communication such as e-mail and Intranet are commonly used nowadays in companies' internal communication. However one cannot be sure that introducing these methods will positively influence effectiveness of OSH communication measured in terms of workers' awareness of occupational risks and necessity to use appropriate preventative measures, workers' participation in OSH-related actions and company's image. In contradiction – taking into account workers' preferences it can be assumed that the most effective communication methods in OSH management are the traditional methods like meetings, written communication and informal discussions. In many companies these methods are introduced as innovative which means that they are new for the company and positively influence the quality of working life. Research methodology: The questionnaire survey has been conducted in 86 big and medium-sized companies with the aim to answer to the question on using electronic and traditional methods of communication in OSH management and the effectiveness of these methods. Managers in the surveyed companies answered the questions concerning communication methods used to inform workers on OSH risks and protective measures used, OSH policy, goals and plans and on the methods of receiving information on OSH-related issues from workers. Additionally, they were asked to evaluate the effectiveness of different methods of communication and to indicate the new communication methods in OSH which have been introduced in a company over the past 3 years. Results: The commonly used methods of communication on OSH-related issues are formal meetings and trainings. They are organised in almost all the surveyed companies to inform employees on risks and protective measures as well as on company policy, goals and plans. Written communication is used in app. 70% of the surveyed companies to inform workers on occupational risks and protective measures. Similarly, in 70% of the surveyed companies informal discussions are indicated as good methods for receiving information on OSH-related issues from workers. The electronic methods of communication are less popular. Only in app. 40% of the surveyed companies Intranet or e-mail are used to inform employees on the OSH policy, goals and plans and the OSH risks. Less frequently, in app. 30% of the surveyed companies, the electronic methods are also used by workers for informing managers on OSH-related issues. Only one of the surveyed companies is using social media in OSH communication. In the last 3 years 27 of the surveyed companies have introduced the new methods of communication on OSH-related issues. The majority of the new methods are traditional ones. At the same time the traditional methods of communications like meetings and informal discussions have been evaluated by managers as significantly more effective than electronic methods. Among the factors which influence introducing the new methods of communication the need to improve OSH performance and company's image were the most often indicated. In more than 50% companies the cost of introducing the new communication methods, measured in terms of time and money, has been evaluated as high. The high cost together with resistance of workers have been identify as the main obstacles in introducing the new methods of communication. More than 50% of companies use external support when introducing the new methods of communication.

# Conformity assessment in the United States

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**Keywords:** conformity assessment; personal protective equipment; United States

## Abstract

Policymakers, employers, and workers have a range of options for minimizing the number and severity of workplace accidents. Among these is personal protective equipment (PPE). In a globalized economy, there is a heightened need for internationally harmonized methods for ensuring that the PPE workers use meet safety requirements. PPE must provide the intended level of protection for the hazards the user encounters. Conformity assessment (CA) is the general term for methods to demonstrate that specified requirements for a product or service are fulfilled. Methods for demonstrating conformity include testing, inspection, auditing, suppliers' declarations of conformity and certification. Conformity assessment requirements impose a financial burden on the manufacturer, who must compete with companies across the globe. Harmonized conformity assessment requirements and related mechanisms such as mutual recognition agreements help equalize manufacturers' competitive positions across national borders. In this context, the heterogeneity of the U.S. conformity assessment system presents challenges. Unlike most advanced industrial nations, the U.S. lacks a single comprehensive CA framework. There is no system comparable to the one described in the EU's PPE Directive, for example, to address occupational PPE. Instead, numerous independent schemes have been developed by public and private sector bodies in response to legislative mandates or market demands. Although there are similarities across these schemes, as a whole they include diverse terminology, procedures, and requirements. In the PPE sector, these schemes are mainly confined to products designed to protect the user against serious, life-threatening hazards (e.g., respiratory protection, body armor, and personal flotation devices). This presentation will describe existing approaches to conformity assessment in the US, focused primarily on PPE programs. The features of this American system will be assessed in the context of ISO CASC standards and the EU PPE Directive. The presentation is based on an in-depth study of 14 public and private-sector third-party schemes conducted in 2014. Ten of the 14 programs examined are designed for PPE. With one exception, these public-sector programs focus on a single category of PPE products, such as respirators. Conformity assessment schemes in the U.S. are operated by both public and private sector organizations. These schemes rely on either government unique or voluntary consensus technical performance standards. Most standards for PPT products do not include conformity assessment requirements. The programs use a wide range of approaches to roles and responsibilities. There is also no consensus on the use of risk and hazard categories, post-market surveillance requirements, or complaint procedures. There is no single source of information about certified products in the U.S. to help consumers and purchasers make decisions. Enforcement and remedial actions available to scheme owners vary depending on whether the scheme owner is a public or private sector body and whether the scheme is based on regulatory or voluntary standards. The U.S. approach is based on the understanding that conformity assessment requirements should provide sufficient benefit in the form of needed assurance of "competence, consistency and impartiality" to justify the cost and effort. Gaps in the US system include conformity assessment mechanisms for products designed to protect against gradual or unexceptional hazards and for most product designed for intermediate risks. Most products are not covered by a system of proactive post-market surveillance. Enforcement mechanisms and corrective actions are weak, even for products covered by public sector programs. Finally, there are few mechanisms for tracking complaints and informing the public about defective products. The implications of the US's decentralized system will be explored, along with the potential consequences of the gaps in the current system. Among those implications are issues of consumer safety and global trade. As one of the three pillars of a quality infrastructure, the gaps in the US system present challenges to the American worker and their employers.

# Surveillance of accidents involving sugarcane harvester machines

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## Abstract

**Introduction** Since the 1990s, the growth of the sugarcane-ethanol industry in Brazil has led to changes in the technical and organizational aspects of the activity. The manual cutting of sugarcane has been gradually replaced by mechanized cutting by harvesters. Sugarcane harvesting machines play a prominent role in the study of agricultural workplace accidents, highlighting their potential to generate serious and even fatal events and to produce sequelae in and other impacts on victims and family members. New technology has altered the profile of risks and accidents, raising questions about the manner in which the new activity, characterized by an intense work pace, productivity pressure and the use of a mechanized harvesting device influences these processes. **Objectives** This study sought to comprehend consequences of the mechanization process of sugarcane farming in the profile of accidents in the sugarcane-ethanol sector. Furthermore, it aimed to identify, in a restudying of cases, aspects of the causal process of accidents involving sugarcane harvesters as well as discuss the limits of prevention measures that have been adopted in these machines. **Method.** The information sources utilized in this research comprised: a) records and reports of workplace accidents analyzed by labor fiscal auditors and stored in the database of the Ministry of Labor and Employment; b) interviews conducted with workers from different occupations that operated in sugarcane cutting, including in accident prevention activities; c) direct observations of workplace situations and activity performed in the context of mechanized sugarcane harvesting; d) documents obtained by Labor Inspection; e) copies of operation manuals of the machines and f) the legal norms applicable to the study objective. This study included the re-analysis of five accidents involving harvesters. The rereading was supported by the concepts presented in the Model of Analysis and Prevention of Accidents (MAPA) with emphasis on notions of description of normal work of operators with their variabilities and attendant adjustments, change analysis, barrier analysis and conceptual amplification of the analysis. **Results and discussion.** The reanalysis showed that the modern sugarcane harvesters operate with relative safety when engaged in normal work, but simultaneously are endangered when variabilities occur, especially those that take the format of technical incidents that require manual recovery. Interruptions of functioning occur in different parts of the machine, namely the topper, cropdivider, chopper knives or elevator of raw material, without provoking breakage, but requiring manual recovery to be executed by the operator himself or a fellow team member. One of the cases occurred during an attempt to release a transshipment tractor. Two of these accidents happened during night work. The current harvesters are not equipped with automatic mechanisms to recovery from incidents. The exposures to risk during corrections were not referenced in the programs of accident prevention of the companies. The study showed that the harvesters had unprotected moving parts and protections that seemed designed only for normal work. Exploring the origins of the cases indicated problems in harvesters' design in association with organizational and managerial aspects affecting control modes adopted by operators under the influence of cultural and contextual aspects. Behaviors of the operators seen as being associated with accidents appeared closely related to the technical characteristics of the harvesters in association with managerial time constraints, production goals and outsourcing. Analyses of these same events conducted by teams from the companies explained the occurrence as events having a single cause or originating from an act or unsafe condition, thus incentivizing blaming of the victims. Finally, opportunities were lost that would have addressed these events as signs of degradation of sociotechnical systems and as essentially organizational processes. Modern harvesters are equipped with a seat interruptor that turns off its technical systems to prevent the correction's application with the machine turned on and requiring that the operator be seated on his work

seat at the time of restarting. The device presents inconveniences not only in that the correction be made blindly, without feedback to the operator about its success or failure before restarting, but also by creating additional cost to the operator in the form of dislocations between the point of intervention and his work seat. If the manual recovery attempt fails, the operator must repeat it; and this condition is described as a stimulus to bypass the measure in question. Furthermore, the interruptor from the seat may not have avoided one of the cases studied in which the operator received help from a colleague that was struck by the chopper knives and also could have been struck during restarting after the correction. This fact may indicate that it would be erroneous to accept that rural machines operate with unprotected moving parts because they are devices in which operator intervention only occurs in a limited duration, for example, during recovery from incidents. Nevertheless, it was possible to identify some encouraging results, primarily the fact that some investigations conducted by fiscal auditors had identified proximal and distal aspects related to the sources and consequences of the accident. They have recommended changes in the whole array of aspects. The current study is revealing and overturns the official paradigm that the problems would be resolved via the mechanization of harvesting. Technological innovation, when it inherits payment for production and the conjunction of pressure of work relations from the manual process, implicitly carries the dangers and risks of that modality. Both modalities (manual and mechanized) appear designed to ensure, at any cost, a continuous supply flow of raw material at processing plants denominated by the workers "beat-back", without considering the human cost involved. The mere introduction of technical improvements without interventions directed toward strategies adopted to address variabilities of work appears insufficient as a strategy for accident prevention in these systems. Finally, the study illustrates the necessity for methods of analysis that use appropriate new concepts and knowledge related to the occurrence of accidents in systems that are adopting organizational and technical innovations. Supported by Fapesp: Thematic project – Work accident: from sociotechnical analysis to social construction of changes. proc. 2012/04721-1

# Production pressures, automatic restart and electrical accident

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**Keywords:** electrical system; electrical fatality; automatic restart; accident analysis; outsourcing

## Abstract

**Introduction:** The Brazilian electricity distribution sector depends on complex systems in relation to technology and work organization. It produces transports and spreads risk in a manner that frequently leads to work accidents. When an incident or accident occurs, the automatic device can reconnect the energy and contribute to the aggravation of the injuries already caused. **Objective:** this study investigates an accident which occurred in the electrical sector to explain the ways in which the on-off device was involved in its occurrence and stimulate reflection as to the best decisions and strategies to prevent repetitions. **Methodology:** The Model for Analysis and Prevention of Accidents (MAPA) was used to investigate the above-mentioned accident to explore the psycho-organizational aspects of its origins. The analysis involved interviews with the injured person and his colleagues; observations made in related work situations, analysis of the relevant documents including the company's report on the case, internal standards, safety norms and training programs. Concepts such as cognitive/ error trap, mode error and automatic surprise and others commonly used in accident analysis were adopted in the quest for a better understanding of the reasons for workers' reactions in accident contexts. **Results:** A team of electricians was changing the electrical cables of an old secondary grid (120 volts) in a residential estate. The naked cables of the primary line (11.2 kilovolts) of the same grid was energized and supported by a wooden crossbar situated on the upper part of the post. The fall of the wooden crossbar supporting the primary line meant that one of its energized cables fell onto the maintenance worker who was below it changing the de-energized cables of the secondary system. The electrician, from an outsourced team, was hit on the left leg by the falling cable and suffered a shock as there was no isolating or protective barrier. Controlled by the automatic on-off device, immediately after the first shock, the grid was turned off and on three times in succession, aggravating the injury suffered. The emergency help was delayed and could only be given after the total de-energizing of the grid of the region where the team had been working. The victim was in a coma for 40 days and during that time his leg was amputated above the knee. **Discussion:** Two facts stand out in this case. The first is that safety management considered that there was no electrical risk involved in the intervention's occurring on the secondary de-energized line situated at 1.4 meters below the primary energized, naked, unprotected cable. Furthermore, the outsourced team was contracted to replace the secondary line, the subcontracted company was in a subordinate position and the work team was unfamiliar with the strategies used by the experienced workers of the contracting company to request the preventive measures used in such situations. The second fact is the practice of leaving the automatic on-off device in position in the area where maintenance interventions are occurring. Thus, upon the occurrence of an accident such as the one quoted above where the wooden crossbar broke and the energized cable fell onto the operator, the system is programmed to renew the power after the first short-circuit and consequent break occurred, re-energizing the grid immediately to diminish the period of the interruption of the supply of energy. Thus, the logic of production, which maintains the supply of energy prevails against the logic of prevention that is set aside, in a situation in which the possible consequences of an accident are always severe. The old conflict between production and safety is a priori solved by guaranteeing the former by using the programmed device to ensure production at any cost. The re-powering device worked as programmed promoting a series of electrical shocks, thus aggravating the injuries resulting from the accident. There is no defect here. The conduct of analysing of this type has to face some challenges, the first of them which being: it is not easy to clarify who - and how many people - are concerned in taking the decisions involved in such a situation. The same occurs in relation to the clarification as to what would have happened differently if the team involved had been experienced inside workers with long experience at working in similar situations at the company. The importance of bringing out the relative power



of action of the safety teams of the different companies should be highlighted. Finally, how is one to explain the silence of the safety teams that have the task of making the obligatory preliminary risk analysis before this type of intervention is undertaken, knowing that in this type of analysis the participation of electricians is essential? This accident reveals the need for the Safety Management System to begin to take into consideration the possible occurrence of such unforeseen incidents as the breaking of a wooden crossbar and provide such basic isolating barriers as were not made available in this case. This case is aggravated by the interference of the automatic on-off devices present in the system, which highlights the need for operators and safety teams to have a deep knowledge of the logic of the functioning of such systems. The teams of accident analysis, whether internal or external to the companies concerned or linked to the public sector, need to develop skills and competencies to act in such a manner as to shed light on the technical and organizational origins of these events. Supported by Fapesp: Thematic project – Work accident: from sociotechnical analysis to social construction of changes. proc. 2012/04721-1

# **A basic occupational health and safety awareness training subject for engineering degree students**

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**Keywords:** Risk prevention culture; basic health and safety knowledge; engineering degree

## **Abstract**

International institutions, as the European Commission [1], have enhanced the importance of the inclusion of occupational health and safety awareness in the academic programs at University. In this sense, member states of the European Union have developed occupational health and safety strategies that include educational issues at the university level. In the case of Spain, the integration of occupational risk prevention contents in the academic programs at university titles was included in the national occupational health and safety strategy for the period 2010-2012 [2]. This work has the aim to include a basic knowledge of occupational health and safety in the academic curriculum of the students of the High Technical Engineering School of the University of Seville (ETSI). The inclusion of occupational health and safety contents in the engineering degrees allows to promote an occupational risk prevention culture in the future for both workers and employers. To do this, the Chair of Occupational Risk Prevention of the University of Seville offers a new optative subject titled Analysis and Prevention of Occupational Risk to the students. The subject consists of a training program that meets the requirements set out in the RD 39/1997 Spanish regulation. It consists of five modules: (I) basic concepts of occupational health and safety; (II) general risks, description and prevention; (III) specific risks, description and prevention in the industrial sector, (IV) basic tools for risks prevention management and (V) first aid. After passing the course, the students get an official title on basic occupational risk prevention. This title will allow the students to assume some rules in occupational risk prevention. E.g. they will assume, both as worker or employer, the risk managements in a small company [3]. The teaching process was design under a practice paradigm. The theoretical knowledge and the tools presented are employed in practical lessons. Teachers have a high qualification in Industrial Safety, Hygiene, Ergonomics and Psychosociology. The subject program includes seminars with external professional experts and technical visits to industrial plants. Students have to pass several partial tests throughout the course. Also, to get the official title, they have to attend 80% of classes at least. The subject was firstly offer to the students of four different degrees of the ETSI (Industrial Technology Degree, Civil Engineering Degree, Chemical Engineering Degree and Aerospace Engineering Degree), at the 2013-2014 course. 58 students chose it and a pass rate of 99 % was obtained. At the present course, the subject has been included in the programme of three degrees more (Energy Engineering Degree, Management Engineering Degree and Telecommunication Engineering Degree) and 129 student have chosen it. In order to assess the degree of acceptance of the new subject by the students, the number of student by degree for the two courses that the subject has been analysed. Regarding the first four degrees in which the subject was offered, an enhancement of 72.4 % is observed in the number of students. Attending this results, it can be concluded that the basic occupational health and safety awareness training subject is being successfully implemented in the different engineering

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# Intervention and dynamization of the action capacity: 10 years of the surveillance work accident system – SIVAT Piracicaba

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**Keywords:** work accident; Surveillance System; Intervention and prevention

## Abstract

In Brazil, public policies, especially those from the Unified Health System (SUS), seek to privilege local surveillance actions of inclusive and universal approach, continuously and systematically, whether it be in the organizational macro-determinants, in the aspects related to conditioning factors exposition, or in the events consequences. Despite the theoretical, legal and conceptual advances made so far, the challenges facing the implantation of integrated interventions oriented by priorities, under social control, which will succeed in making significant transformations in accidentality, are still enormous. The purpose of this article is to analyze the history of the implantation and consolidation of an information system integrated into interventions, called SIVAT (Work Accident Surveillance System) developed in Piracicaba (São Paulo, Brazil) and discuss aspects of this experience between 2004 and 2013, when the system completed 10 years of full activity. It has been decided to use an analytical descriptive methodology which can be described as a case study, although it is also of essayistic kind, seeing that it contemplates the authors/actors perception who were actively involved in these happenings. The investigation consisted of document analysis, which made it possible to recover the main initiatives of CEREST and partner institutions through SIVAT – Piracicaba, associated with the presentation and critical examination of work accidents indicators from the time series of the studied period. Results: During these 10 years, a large number of actions and interventions were undertaken. For ease understanding: (1) Surveillance and prevention: including activities in work processes, negotiations and inter-institutional interventions in some economic sectors, which emerged as important, such as those of civil construction, metallurgy, textiles, agriculture, red ceramics, carpentry, transport, jewelry manufacture and costume, supermarkets, bakery and the electrical sector; (2) Attendance: by which, based on health assistance given to workers with musculoskeletal surveillance, interventions and changes were undertaken in a large food-sector company and, simultaneously, as a result of dialog with a Canadian model (Sherbrook), a professional rehabilitation proposal was designed for the municipality, which has been used as a model for the whole country; (3) Promotion and continuing education: including activities such as Post-Graduation course - Lato sensu - on ergonomics, lectures, workshops, symposiums, congresses and meetings related to workers health, work safety and ergonomics; (4) SIVAT database implantation, maintenance and improvement activities: which includes accident indicators to order field priorities. Between 2004 and 2013, SIVAT registered 85,674 work accidents, 81,726 of which occurred among formal sector workers (95.4%) and 3,948 among informal workers (4.6%). The work accidents annual incidence in that period was 72.42 per 1,000 workers, though no significant statistical tendency (whether of increase or decrease) was found ( $p>0.05$ ). The incidence has been higher in the formal economy sectors and greatest in the mining sector (138.84/1,000), followed by farming (115.69), civil construction (110.78) and transformation industry (107.04). The CEREST

identified 15 companies that have been important participation on the city's accidentality during this period. They presented large frequency and bigger incidence rates. The work accidents incidence average in this companies was 164.15 by 1.000 employees (by year), more than twice that observed in all formal sector. Although no significant statistical tendency (whether of increase or decrease) was found ( $p>0.05$ ). These companies have been object of systematic intervention, and the lowering of their accident rates is yet a big challenge to CEREST and social partners. To face this challenges it is worth noting that the CEREST has counted on partnerships such as those with Labour Attorneys and auditors of the Labour and Employment Ministry, universities and research centers, resulting in the development of tools such as the Model for Analysis and Prevention of Work Accidents (MAPA) and the creation of the Work Accident Forum which, besides its internet homepage ([www.forumat.net.br](http://www.forumat.net.br)), is now completing the 45th edition of Open Meetings. Conclusions: SIVAT – Piracicaba has been a basis for conducting various interventions, previously non-existent, guided by priorities made possible by information system. The data collected by the emergency attendance system were crucial, because beyond the universal coverage provided for cases from both formal and informal sectors, they were seen to be more agile, more trustworthy and adequate for surveillance activation in serious and fatal cases. The epidemiological data were strategic as a basis for the surveillance interventions in sectors and companies with higher accident rates, reinforcing and giving greater legitimacy to CEREST and partnership institutions. Among the strategies adopted, sectoral interventions and negotiations were given greater value, because they were seen to be more fruitful than specific, fragmented ones such as those of the spontaneous demand type. Inter-sectoral and inter-institutional negotiations produced greater commitment on the part of the actors involved, overcoming the defensive postures normally adopted by companies when they face legal actions. The oscillation observed in the indicators still calls for further analysis, but may reflect the influence of multiple factors isolatedly or in conjunction as, for example, improvements in the collection and registration of events; limits to the effectiveness of the interventions in the general situation of the municipality, even those with good results in certain companies; oscillations and diversification of economic activity and reactions to changes in the legal context. Finally, the findings suggest a convergence of changes in the material basis of some activities affecting their accidentality with possible effects of the dynamic of the implantation and consolidation of the interventions based on the information system. SIVAT – Piracicaba serves as a reference for systematic and continuous public policy, even though it faces obstacles and challenges such as growing demand for its services and the difficulties faced in maintaining and increasing the team. This initiative, though successful, is still quite isolated within a context of official directives encouraging growth at any cost and the weakening of social policies. Supported by Fapesp: Thematic project – Work accident: from socio technical analysis towards social construction of changes. Proc. 2012/04721-1

# Research into zero accident vision: exploring commitment to zero accident vision in organisations in seven countries

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**Keywords:** Zero Accidents Vision; Commitment; Europe; questionnaire

## Abstract

**Introduction** The Zero accident vision (ZAV) is a promising new paradigm, which has been developed in industrial practice and offers new perspectives on accident prevention. The basic idea of ZAV is that all accidents are preventable. It promotes the adoption of a high standard safety culture and a 'vision zero' concept in all sectors of work life. In the Zero Accident vision research project, we aim to better understand the factors that contribute to successful accident prevention in companies that have committed themselves to the Zero Accident Vision. Specifically, the study investigates the levels of self-reported personal commitment to ZAV and the perception of organizational commitment and relates this to measures of safety climate, safety learning, safety outcomes and safety communication. In this abstract we present some preliminary findings on both the individual and organizational commitment to ZAV in the participating countries. In the full paper we will elaborate on the relation of this commitment with the other dimensions – learning, communication and climate. The aim of the paper and the presentation is to explain the key characteristics of companies that show high commitment to ZAV. Overall approach The overall research project into ZAV is carried out in joint collaboration with several research institutes and as a result a total of 27 companies participated, in seven countries. The research project used three main approaches to study ZAV within organisations:

- A questionnaire study that builds on existing questionnaires, and measures the aspects: commitment, learning, climate and communication on an individual level.
- A brief questionnaire that gives information on ZAV implementation and goals on a company level
- Interviews with key actors for each of the participating companies, to provide context for the quantitative results.

In addition to these measures a focus group is organized in each country with representatives from the participating companies. These focus groups had a twofold aim: for the companies to share their experiences and good practices, and for the researchers to identify common factors that characterize ZAV companies. In this abstract we mainly focus on the findings from the questionnaire on an individual level. The interviews are used for interpretation of the results.

**Measuring commitment** Commitment to zero accidents vision is explored in the questionnaire through two dimensions. The first dimension combines 5 items about the personal commitment, and the second dimension combines 2 items that explicitly ask about the organizational commitment to ZAV. Statements that were for example used to assess the individual commitment are: 'I think that all accidents (injury-people & damage-objects) can be prevented'; 'I am personally committed to a zero accidents vision (preventing all accidents - injury to people and damage to objects)' and 'I think that safety performance can always be improved'. To assess organizational commitment to Zero Accidents vision, we asked each participants to respond to the statements: 'Our workplace is committed to a zero accidents vision (preventing all accidents - injury to people and damage to objects)' and 'The Management in our company is truly committed to a zero accident vision (preventing all accidents - injury to people and damage to objects)'. There were four answering categories for each of these items, ranging from 'strongly disagree with the statement' to 'strongly agree'. Preliminary findings For this study, 8819 questionnaires are completed by employees in 27 companies: 254 in Belgium, 983 in Denmark, 487 in Finland, 1803 in Germany, 3573 in the

Netherlands, 470 in Poland and 1249 in the United Kingdom. The mean values on individual and organizational commitment for each country show that self-reported commitment to zero accidents vision is highest in the United Kingdom. In Belgium, Finland and Poland there are clear differences in how people reflect on their own commitment and the commitment of the organization to zero accidents. The results from the interviews and focus groups can be used to investigate and explain these differences in further detail. Expected results Currently the project group is finalizing the analysis of the interviews. Also, additional quantitative analyses are performed, to determine how the values on organisational and individual commitment relate to the values on the other dimensions: climate, communication and learning. We will elaborate on these results in the conference presentation. Acknowledgement The study is a joint collaboration project within the PEROSH EU network of occupational safety and health institutes. It is financed by the German Social Accident Insurance (DGUV).

# Health and safety in small work of construction: a comparative analysis between Brazil and Portugal

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**Keywords:** Health; safety; small work of construction; legislation

## Abstract

The construction industry is a sector that has specific characteristics in the productive economy universe, whether in Portugal or in Brazil, by playing a key role in the development of both countries. Currently, in Portugal the number of jobs in the Portuguese construction increased by 3% in the 3rd quarter of 2013 to the last quarter of that year, from 288.9 to 298.1 thousand workers. The contribution of public works in construction for Portuguese Gross Domestic Product (GDP) was, in 2013, 0.9% (INCI, 2013). In Brazil, according to data from the São Paulo Association of Public Works Entrepreneurs (Apeop, 2015), for the year 2013, this sector accounted, alone, for 5.4% of GDP, with more than 2 million workers, and not counting the jobs created throughout its production chain that can reach 3.5 million or more people. However, the construction sector, both in Portugal and in Brazil, also excels due to high levels of workplace accidents. In Portugal, according to the Authority for Working Conditions (ACT), there were 308 serious accidents in industrial activities in 2014 and of these, 88 were in the construction industry, as well as the 135 fatal accidents, the construction activity held 41 cases, remaining at 1st place among all other activities in the last three years. Data from the Superior Labor Court (TST, 2015) show that, in Brazil, in 2010, there were 54,664 accidents in the construction, making it the sector the second in number of accidents and, as Brazilian Social Security, in 2013, as the second activity in fatal accidents. In this context, Brazil and Portugal have revised and/or created laws in order to change these statistics and, in particular, ensure workers' safety and health. In Brazil, the relevant legislation is composed of a set of Regulatory Norms (NRs), while in Portugal, the regulation are made through Decrees-Law. The main purpose of this work is to characterize the small construction industry in Portugal and in Brazil, and also to make an analysis of the associated laws, observing all the conditions provided to characterize and to place the small construction sites. The present study aims to compare the laws regarding work condition in terms of health and safety in small construction sites in Portugal and Brazil, in order to identify possible future contributions. Methodologically, the study consists of two parts. One that consisted in a literature review to contextualize the topic, and the survey of the health and safety conditions in both countries. The second parte is an empirical research based on semi-structured interviews with professionals from various areas of instruction and performance in the construction industry in Portugal, in order to analyze their understanding regarding the health and safety policies and legislation on small construction sites. Through the obtained results, we describe, briefly, as Brazilian law is applied in this sector and we also discuss which are the main problems found and the future challenges. For Portugal, we characterize the current implementation of the existing Decree-Law, taking as its premise the same analysis that is done for Brazil. According to the obtained results, it is possible observe that in Brazil the supervision of small construction sites is still ineffective – because of the size of the country and to the fact that a huge number of small construction sites are carried out in homes, offices and facades, where the nomadic nature hinders the compliance of health and safety aspects - and that, in Portugal, the supervision seems to be more frequent and, possibly, more effective. This comparative analysis may result in concrete indications of how a country can have benefits from the observed and experienced positive practices in other countries, and, in that sense, to use the Portuguese model to be applied in the Brazilian reality. As conclusion, we made comparisons between the two countries, prospecting options for situations where Brazilian law still seems to be at a disadvantage in relation to Portuguese legislation.



# Characterizing occupational accidents patterns using multiple correspondence analysis

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**Keywords:** Accident Patterns; MCA; Multivariate Analysis; Accident Analysis

## Abstract

Analyzing occupational accidents characteristics, circumstances and causes is a critical activity to support organizational learning. In the past, research has been studying occupational accidents and enforced the need for multiple cause analysis. However, the most commonly used statistical techniques for characterizing accidents are either univariate (one single variable is analyzed), or bivariate (crossing two variables per analysis), not allowing to consider the true complexity involved in the events. Considering the type of data collected when recording and analyzing accidents (mainly qualitative, descriptive, categorical), Multiple Correspondence Analysis (MCA) is a useful technique for a multivariate analysis. MCA allows a multidimensional analysis of categorical variables and it is used to detect underlying structures in a data set by representing data as points in low-dimensional Euclidean spaces. This statistic analysis technique has been fairly used for the characterization of road and pedestrian accidents (e.g., Factor et al., 2010; Prato et al., 2012). However, its use in studying occupational accidents is very recent and few studies are available in the literature. For instance, Rivière and Marlair (2010) used this analytical approach for identifying incident typologies in biofuel industry. In this study the authors identified five main incident typologies that contributed for understanding safety needs pertaining first-generation biofuel supply chains. Pérez-Alonso et al., (2012) analyzed accidents at work in the greenhouse-construction industry in Spain for the period 1999 to 2007, based on a sample of 180 accident reports. The accidents were characterized by 5 variables: the day of the week in which the accident occurred, the hour of the day, type of accident, the region of Spain in which the accident happened, and the resulting injury. In this study MCA was one of the techniques used for the data analyses and allowed to identify 5 accident patterns. In another research, MCA was used to study maritime accidents in the United Kingdom aiming to point out patterns of contributory factors analyzed during the investigation (Chauvin et al., 2013); based on Reason's "Swiss cheese" model of accident causation, the authors studied the human and organizational factors in maritime accidents using the HFACS (Human Factors Analysis and Classification System) tool. The HFACS was applied to analyze 27 collisions involving 39 vessels. MCA and hierarchical clustering revealed three patterns of factors: one pattern revealed that collisions in restricted waters were linked to communication and Bridge Resource Management deficiencies; another pattern revealed collisions with deficiencies at every level of the system; the third pattern was characterized by non-compliance with the Safety Management System. More recently, Carrillo-Castrillo et al. (2015) applied MCA for studying accidents notified in the Manufacturing Industry in Andalusia aiming to analyze the association between Task (using ESAW variable "Working Process") and Accident Mechanism (using ESAW variable "Deviation"). Considering this state of the art it is clear that MCA can be very useful for accident analysis but until now only few studies used it and all of them were conducted in very specific industries/activity sectors. Therefore, the present study aimed at finding occupational accidents patterns from multiple categorical variables and explores their inter-relationships across sectors. Using a large national database of occupational accidents from the Portuguese Office for Strategy and Planning (GEP), covering 3 years (2005-2007), this research maps accident profiles through Multiple Correspondence Analysis. Data analysis covered a number of relevant variables, namely: "Specific Physical Activity"; "Deviation"; "Contact"; "Part of the Body Injured" and "Type of Injury". MCA allowed the authors to describe the associations and provided a graphical display of the multidimensionality of the space, representing all the categories of the variables in a sub-space with the minimum number of dimensions possible. Results revealed four main profiles: accidents related to "man-machine" interaction (i.e., work with machines or tools); accidents related to "bad movements and

overexertion of force"; accidents related to "trips and falls" and, the forth profile can be interpreted as "undifferentiated" accidents. These patterns were further explored in order to identify specificities associated with (1) organizational variables employer/company (i.e., "economic activity", "size of enterprise") and (2) data about the employee who suffered the accident (i.e., "age", "sex"). The main findings support the usefulness of MCA in accident analysis and further implications will be discussed.

# Impact of R&D technology and economic growth on companies' occupational safety and health strategies

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**Keywords:** R&D technology; Economic growth; Occupational Safety and Health

## Abstract

As new technologies and globalisation are reducing the importance of economies of scale in many activities, and larger firms are downsizing and outsourcing more functions, the weight of SMEs in the economy is increasing. The potential of small companies has been recognised and it is appreciated that employment and economic growth to a large extent depend on these companies. Both political and scientific interests in occupational safety and health (OSH) in small companies have, therefore, grown considerably during the last decade. In terms of OSH, small businesses present a challenge: they are difficult to regulate, as they are typically heterogeneous, geographically scattered, lack cohesive representation and have a short life cycle. The need to focus OSH research on small businesses is now recognised, but effective mechanisms to reach, assist and impact these companies continue to be a challenge. To date, most OSH research and interventions have been primarily focused on large companies, as reported by the European Agency for Safety and Health at Work. The European Agency for Safety and Health at Work (EU-OSHA) promotes good safety and health at work environments as an integral part of the smart and inclusive growth objectives of Europe 2020. This model meets the priorities for occupational safety and health research in Europe for the years 2013-2020, which includes keeping people healthy and active for long periods, having a positive impact on global productivity and competitiveness. Thus, OSH research have a role to play in delivering smart, sustainable and inclusive growth. Reaching the high-level goals of Horizon 2020 and the overall EU policies for the next decades will depend on the success of new enabler technologies such as those needed for new energy policies, climate adaptation and future manufacturing. However, new technologies will succeed only if the benefits are clearly visible and the potential risks are regarded as acceptable by society. This requires identifying and addressing stakeholder and public expectations and responding to their concerns in order to build trust and confidence and to show that the new technologies are 'well under control'. This in turn requires identifying and assessing the safety and health risks associated with new technologies and integrating OSH aspects in the development of new technologies and processes, as well as strengthening risk communication and OSH communication. This paper proposes a knowledge-driven horizontal R&D endogenous growth model to explain, for innovative countries, the co-movement of the respective R&D intensity, economic growth and the firm-size growth, by exploring the short-medium-run and the long-run growth effects. Bearing in mind some recent literature, it is possible to improve the R&D technology by considering that R&D is more labour intensive through time as complexity increases. It is also possible to do that by introducing risk assessment, that the diffusion of designs is affected by coordination, organizational and transportation costs, and that a potential entrant will come up with the right idea is reduced because of the presence of a larger number of entrants. We show that when the economy is not initially on steady state, it can take a saddle path towards the unique and locally saddle-path stable interior steady state. The transitional dynamics and the steady state behaviour of our model are then consistent with, respectively, the time-series and the cross-sectional evidence. According to reports of the Organisation for Economic Co-operation and Development (OECD), undoubtedly the capability to innovate and to bring innovation successfully to market will be a crucial determinant of the global competitiveness of nations over the coming decade, which is accommodated by our model. There is growing awareness among policymakers that innovative activity is the main driver of economic progress and well-being as well as a potential factor in meeting global challenges in domains such as the environment and health. It is reported in literature that the influence of R&D intensity on firms' growth is an issue of great interest and complexity. R&D investment increases absorptive

capacity, i.e. the capacity to absorb knowledge created from the relationships formed with agents outside the firm, as well as the capacity to use that knowledge to increase firm performance. In consequence, firms have to adjust their priorities regarding the investments, namely in the OSH domain. In fact, firms are dealing with limited financial resources, and as a consequence, they need to make decisions about financial resources, being the management strategies for productive process often dissociated from OSH issues.

# Risk, trust and "othering" in the offshore supply chain

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**Keywords:** Trust; interorganisational cooperation; offshore supply chain; safety

## Abstract

Reason (1997) argues that the subcomponents of safety culture are based on an underlying element of trust, and research show that high levels of trust in relationships between operators correlates with and contributes to high levels of safety in high risk enterprises (Wildman 2012, Curşeu & Schrujer, 2010). Additional research clearly indicates that generating high levels of trust is a never-ending concern and organisations need to constantly encourage processes generating trust and be vigilant about those that undermine it (Giddens, 1994; Skarholt and Torvatn, 2010; Skarholt and Finnestrand, 2008). The purpose of this paper is to explore how trust is generated in relationships between the actors engaged in the supply chain on the Norwegian continental shelf. The supply chain is characterised by many different actors (such as operator companies, shipping companies and supply bases) who mutually depend on each other to achieve safe and efficient outcomes. They operate in complex collaboration, but have different tasks and responsibilities, and to some extent different interests. The offshore industry in Norway is renowned for its high degree of trust, with strong and resilient tripartite cooperation over many years. This has not always been the case, however, and historically strong trade unions and staunch employers, combined with a number of serious incidents and accidents, contributed to widespread distrust. In addition the oil and gas sector in Norway is hierarchically structured with the major oil companies on top and various contractors below. Strong cultural variations among the participating companies, based on factors like education, rank and where in the supply chain the companies are positioned, also contribute to challenges concerning the generation and maintenance of trust. In this paper we focus on the relationships between offshore installation and supply vessels as these two types of actors occupy structurally and hierarchically opposite positions with significant cultural differences between them. In 2001 the trust situation in the offshore industry in Norway was rather poor with several conflicts between the parties and a number of severe accidents. A research project at the time identified interactional issues as one of many contributors to the high number of accidents, and a number of initiatives to improve interactions and avoid future accidents were designed on the basis of that research (Kongsvik and Solem, 2013). The frequency of accidents fell dramatically immediately following the implementation of these initiatives, and has stayed at a low level since. Operators on vessels and platforms have since reported that the initiatives led to a noticeable increase in the trust between them. Recent fieldwork reveals, however, that trust is still undermined and distrust generated in many of the relationships between platform personnel and vessel crew. These observations indicate that trust is vulnerable to erosion and processes to enhance and improve trust must be perpetual and ubiquitous. Trust relies on mutual understanding built up by repetitive interactions over long time and it is primarily in daily work situations such trust generating processes should be observed, not in or just after a campaign or process. Trust is about predictability and an important characteristic of social relations and systems (Sørhaug 1996) that has been widely studied in organizational research (Wildman 2012). The concept can be defined in many different ways, highlighting different aspects of individual cognition or the characteristics of relationships, and there is no consensus among scholars about which definition to use. This paper therefore does not build on one specific definition, but sees trust as a quality inherent in dealing with uncertainty. Trust is a projection onto the future, but always based on evaluations of actual performances and utterances in the present and the past, and thus also an evaluation of the qualities of the present relationship. Consequently the paper is concerned with many different aspects of trust; from actors' judgement and/or assumption (confidence) about the trustworthiness of others (DeSteno 2014) via the willingness to accept vulnerability on the basis of that assumption (Mayer et al., 1995; Rousseau et al., 1998), to trust as a reciprocal quality of a relationship where actors actually behave in accordance with each others' interests (Zand, 1997). The paper assumes that trust is an emergent phenomenon, constantly regenerated or undermined by how people interact; how much knowledge they have about each other's work situations and operational concerns; how they actually look after

each others' interests etc. On this basis data has been collected through fieldworks on PSV's and interviews with officers, ABs, crane operators and platform deck operators. The paper describes and analysis interactions between these actors; their shared knowledge about each other's work situations and concerns; their representations of each other and general perceptions of the trustworthiness and competence of the operators they interact with.

# FRAM-AHP: a systemic methodology for occupational risk assessment

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**Keywords:** FRAM; AHP; Occupational risk assessment; Construction industry; resilience engineering

## Abstract

Traditional tools for occupational risk assessment like preliminary hazard analysis, hazard checklists, fault trees are based on the isolation of hazard activities from the entire process and the development of specific measures to avoid/minimize the occupational risk. Their basic assumption is that the system's structure and even its behavior are known and do not change with time. Such methods require the system linearization, a detailed description of the system and risk scenarios, and may not be adequate for systems that are dynamic, incompletely described, and underspecified, like most of modern socio technical systems. To deal with dynamic environments, where daily routine activities require flexibility rather than rigidity, Resilience Engineering (RE) has developed new methods and tools for system modelling. According to RE the main target for safety management is to increase the ability of the organization at all levels to adjust its operation to changes and disturbances. The Functional Resonance Analysis Method (FRAM) is based on RE principles and concepts aimed at describing and analyzing emergent behaviors in complex sociotechnical systems. This research utilizes FRAM combined with Analytic Hierarchy Process (AHP) – FRAM-AHP method - for occupational risk assessment at the green construction industry. Construction is a complex environment involving multiple stakeholders and groups working under different contractors. Work activities occur under constant change and varying demands. In this context, as workers move along their daily journey, dealing with sacrifice decisions, their health and safety often are threatened by their own activities or carried out by other people, groups or contractors. FRAM-AHP method is based on system functioning, not in the identification of specific hazards as traditional tools. According to FRAM the analyses of performance variability and how variability may combine and resonate are characterized as a quality rather than a quantity. The main steps of a FRAM analysis are: (1) setting the goal for modeling and describing the situation to be analyzed; (2) identifying the main functions of the process, and characterizing them, according to input, output, preconditions, resources, time and control; (3) characterizing the actual/potential variability of functions; (4) considering both normal and the worst-case variability; (5) defining functional resonances, based on potential/actual couplings among functions; (6) and providing ways to monitor the performance variability. The FRAM-AHP method aims to introduce a multi-criteria decision-support method to quantify FRAM analyses to be used for risk assessment purposes. Multi-criteria decision-support methods like AHP are used in situations involving multiple objectives, various decision-makers, and the simultaneous treatment of complex issues. In this sense, this research contributes to the evolution of FRAM, by proposing the application of the analytic hierarchy process (AHP), to investigate the relative importance of the criteria and alternatives used for the identification of phenotypes of performance variability, as well as the aggregation of variability. The construction and use of the AHP model are developed in four stages; namely: structuring the hierarchy in order to identify the main goal, criteria, sub-criteria and alternatives; data collection of value judgments issued by experts; calculating the priority of each alternative, and consistency analysis. The case study results indicated that FRAM/AHP enables the simultaneous participation of multiple experts in different steps of analysis, and led to the reduction of subjectivity associated with the occupational risk assessment in complex socio-technical systems.

# A comparison of inspection practices between the Danish and Swedish work environment authorities

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**Keywords:** Work Environment Authorities; National differences; Inspections; Mixed method

## Abstract

Background Denmark and Sweden are generally considered culturally, historically, and politically similar societies. Thus, it is surprising that the general Danish occupational injury rate is twice the rate of Sweden, and that Denmark has a 33% higher rate of fatal occupational injuries. There are only minor differences in the work environment legislation between the countries, as both are members of the EU. However, there may be differences between the countries in how the legislation is enforced by the respective national Work Environment Authorities, which may help to explain the different injury rates. A recent Cochrane review has shown that labour inspections lead to a decrease in injury rates in the long run, and that it does make a difference how and why inspections are carried out. However, there is considerable uncertainty as to what the most effective and efficient approach is, as there is a lack of description of the inspection process in the scientific literature. Aim The aim of the current study was to identify differences in labour inspection practices within the construction industry between the Danish and Swedish Work Environment Authorities. Methods The study was based on a mixed-method approach combining observations of inspections in Denmark (n=18) and Sweden (n=12), interviews with Danish (n=7) and Swedish inspectors (n=5), and questionnaire responses from the inspected workplaces (n=16) measuring how they perceived the inspector and the possible benefits of the inspection. Field notes of the individual inspections were analyzed based on three major themes: (1) The role of the inspector vis-à-vis the inspected (as controller, expert and sounding board), (2) the inspectors' interactions with the inspected (the use of autonomy-supportive tactics and coercive tactics), and (3) reactions of the inspected (error correction, changed mindset, negative behaviour, positive behaviour). Results The primary role of both Danish and Swedish inspectors was as controllers, who checked if rules were followed. Another role, which was evident in 2/3 of inspections in both Denmark and Sweden, was the expert/educator-role, where the workers or managers being inspected ask the inspector questions to gain knowledge. The expert-role is an indication of the existence of a certain level of trust in the relationship between the inspector and the inspected company, and an acknowledgement of the inspectors' expertise from the inspected parties. A third role of the inspector was only identified in a few instances in Sweden. This was the role of being a sounding board, where the inspector steps out of the authoritarian controller or expert role, and enters into a more equal role relationship while trying to initiate a problem solving dialogue with or between the inspected workers/managers. Although the use of autonomy-supportive tactics (providing rationale, choices, empathy and praising the inspected companies for the initiatives that they have taken) was widespread in both countries, they were employed more regularly in Sweden. All the Swedish inspections include autonomy-supportive tactics, while they were only evident in 70% of the Danish inspections. Furthermore, the autonomy-supportive tactics were more prominent in the individual inspections in Sweden than in Denmark. Coercive tactics (pressure, surveillance and deadlines) were based on the inherently unequal relationship between the inspectors and the inspected, and were carried out both directly and indirectly. The most widespread direct coercive tactic was the issuing of written enforcement notices. The Danish inspectors had a greater legal possibility to issue fines, which influenced practice, in terms of also using the threat of such fines coercively. Indirect coercive tactics were seen when the inspector pointed out unsatisfactory conditions, with the unspoken but underlying threat of further action if not corrected. In both Denmark and Sweden there was a clear tendency that direct coercive tactics were more pronounced when dealing with major violations. Immediate corrections (as soon as the inspector pointed out issues the inspected parties made the necessary corrections) were a more predominant reaction in Denmark than in Sweden. In most instances workers and managers complied with instructions from the inspectors without much reflection. Only rarely did they enter into a discussion with the inspectors that showed an interest in challenging their current action theories, which would be indicative of a changed mindset and a genuine interest in doing things differently. In some instances the inspected



parties also reacted with negative behaviour, such as expressing disagreement, non-cooperation or lying. Negative behaviour was more widespread in Denmark than Sweden. Conversely, positive behaviour, such as showing gratitude for the work done by the inspectors and acknowledging their importance, was more widespread in Sweden. The questionnaire data revealed that the inspected Swedish companies had a significantly more positive perception of the inspectors and the benefits of the inspections than the Danish. Discussion The results showed that although the primary roles of the Danish and Swedish inspectors were largely the same, there were also some differences. The greater use of autonomy-supportive tactics by Swedish inspectors, may decrease the number of future violations at the inspected Swedish companies, as previous research has indicated that the use of autonomy-supportive tactics is more effective than coercive tactics in resolving worksite non-compliance with regulations. This was also indicated in both the questionnaire data and the observations of reactions from the inspected companies, which pointed at more negative behaviour from the inspected Danes, while Swedes showed more positive behaviour and had more positive perceptions of the inspector and the inspection. The larger reliance on coercive tactics by Danish inspectors may encourage negative behaviour, but on the other hand negative behaviour on behalf of the inspected party may also trigger the use of more coercive tactics among the inspectors. Such relations between the inspectors and the inspected may be counteractive to occupational safety. They may also be indicative of attitudes and authority-company relations at a more general societal level that through several mechanisms may influence occupational safety. Conclusion There were differences in the enforcement practices of the Danish and Swedish Work Environment Authorities' inspectors, which may lead to greater adherence to health and safety regulations in Sweden. This may partly explain the difference in occupational injury rates between the two countries.

# Safety of textiles with nanomaterials

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**Keywords:** Nanomaterials; Safety; Textiles; Consumer Products; Skin Contact

## Abstract

Recently there has been a rapid emergence of nanotechnology into several consumer products, which has led to concerns as regards the potential risk for human health following consumer exposure. But there is also a concern in terms of occupational safety and health, related to the exposure of workers involved in manufacturing, processing and handling of consumer goods containing nanomaterials. There is a knowledge gap between the technological progress in nanotechnology and nanosafety research which is estimated to be 20 years, and it is likely to expand. The European Agency for Safety and Health at Work has established as priority for research related to the safety and health in Europe during the period 2013-2020 the increase of knowledge on nanomaterials in occupational settings, including new generation nanomaterials and understand their characteristics in relation to toxicity in biological systems. The risk for consumer and for workers is linked to the characteristic properties of certain nanomaterials that make them different from their macroscale counterparts and will be determined by the chemical composition of the nanomaterial, its physicochemical properties, the interactions with tissues and the potential exposure levels. Ingestion exposure via the gut, airborne exposure via the lungs and dermal exposure are the most important exposure routes to be considered in a risk analysis. In addition, the increasing use of nanomaterials, including for industrial purposes, raises specific concerns regarding their disposal at the end of their life cycle with the unavoidable release to the environment that may lead to indirect human exposure. Textiles are one of the most heavily traded commodities in the world. The industry is very diverse and its products are used by virtually everybody from private households to large businesses. The textile industry is already an important user of nanotechnologies and there are a significant number of “nano-textiles” in the market, including many consumer goods, with the incorporation of nanoparticles. For food (including additives and packaging) and for cosmetic products the European Union (EU) regulations already include specific mention to nanomaterials. But this is still not the case of textiles. Nanotechnology is used in textiles mainly in order to obtain specific functionalities. The most common effects are: water and dirt repellency (including self cleaning properties, also called “lotus leaf” effect), antibacterial properties, protection against ultraviolet radiation and flame retardancy. These properties are obtained by the incorporation of nanoparticles like titanium dioxide, zinc dioxide, silver and nanocomposites. Although it is possible to incorporate the nanoparticles directly in the production of the fibers, the most frequent application is made in the final phase of the textile manufacturing process, which corresponds to fabric finishing. In terms of occupational safety, it is important to consider the workers that are involved in the fabric finishing plants, which have to handle chemical preparations and fabrics containing nanomaterials. It is also essential to take into consideration all downstream workers, with special emphasis on the clothing manufacturing. In fact, the workers involved in cutting, sewing and garment finish have to manipulate all the time large quantities of fabrics, potentially releasing nanoparticles. The General Products Safety Directive (GPSD) is intended to ensure a high level of product safety throughout the EU for consumer products that are not covered by specific sector legislation, which is the case of textiles. It is foreseen to modify GPSD into a Regulation, including then a specific mention to nanomaterials. The growing concern about the possible negative effects of nanomaterials on humans and on the environment can lead to restrictions to “nanotextiles”. In fact, for instance, there is already an ecological label which bans the presence of nanofinishes in textiles. Also in the recent discussion of the new version of the EU ecolabel for textiles, there were several voices to exclude nanomaterials. It is essential to develop further studies to understand the type of integration of the nanoparticles in textiles and the mechanism of release. There are different exposure routes of the human body to nanoparticles. In case of textiles, skin contact is particularly relevant, although, especially in the case of babies who often suck textiles, ingestion can also be relevant. It is known that textiles lose between 5% and 20% of their mass during use as a result of abrasion, mechanical influence, irradiation, water, sweat, washing detergents

or temperature variations. It is then expected that “nano-textiles” may release individual nanoparticles, agglomerates of nanoparticles or small particles of textile with or without nanoparticles. These nanoparticles can then interfere with workers, consumers and natural ecosystems. In this paper, a review of this topic is presented, including the work that is being carried out under the auspice of the European Standardization.

# Resilient human intervention in the face of uncertainty

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**Keywords:** Resilience; uncertainty management; case studies

## Abstract

Many current risk management systems have permanent designed-in measures, standard procedures and rules in place to avoid incidents and things going wrong. These procedures, rules and permanent measures are generally designed to cope with foreseeable risks derived from hazard identification and risk analysis, taking account of events which have happened in the past. Procedures and rules are intended to constrain behaviour within a safe boundary and deviations from them may be termed “error” or “violation”. This approach has been criticised for not dealing with how people adapt to variations, changes and disruptions in the workplace and how they cope with unexpected events. With increasingly complex technologies and organisations and the emergence of possible new risks there are increasing uncertainties associated with successful outcomes resulting in demands for more complex systems to be resilient. In hazardous industry, resilient human intervention is one of the tools to adapt to change and to cope with uncertainties and complexity. The need for resilient intervention occurs when there is a change in conditions that cannot be responded to by the standard normative approach. The important aspect of resilience which characterizes many definitions across many fields is an ability of an entity (e.g. person, company, city, ecology) to adapt to or absorb change and disruption such that the entity continues to be like it was before the change. One of the key features of a resilient system is that it can adapt to allow the system to change with the encountered variabilities rather than to try to cancel them out – it can survive within a certain bandwidth of change. While predetermined procedures, automated responses and routine ways of working may be adequate to deal with the expected, the current authors have found that dealing with the unexpected requires a vigilant reflective scenario-thinking approach. The nature of the resilient mind and the resilient organisational safety management processes are the subject of this paper. The parameters of resilient human intervention to manage high risks were investigated in a European SAFERA project conducted by the Resilience Success Consortium (2014) and funded by the Dutch National Institute of Public Health & Environment (RIVM) and the French Foundation for Industrial Safety Culture (FonCSI). The aim of the project was to model success as opposed to a failure where outcomes of deviations are successes, not accidents. In the project, interviews were carried out to determine how people managing high risk succeed. Interview questions were based on the four cornerstones of resilience according to Hollnagel : Anticipating, Learning, Monitoring, Responding. Interviews were held with 18 people, face to face or online. Interviews were conducted with: • Mountaineers (also called alpinists) who are directly confronting natural hazards (4); • Rope Access Workers carrying out dangerous maintenance on man-made structures (3); • HS&E Managers and Operations Managers of high hazard chemical (6), petrochemical (3) and steel plants (2). From the interview data Van Galen & Bellamy (2014) developed a quadrant of Time to react (short, long) X Uncertainty (high, low) which shows the distinction between normative responding and resilient responding, depending on the amount of uncertainty and the time left to react to change. On the high uncertainty side there is something that could be called ‘reflective human intervention’ and there is ‘reactive human intervention’. In the case of reflective human intervention it will be possible to reflect, to gather more information, have the right disciplines around the table, develop and follow golden principles and be deliberating and mindful when taking decisions. Such behaviours will be aimed at uncertainty reduction. In the case of reactive human intervention there is no time or almost no time to reflect. It will then come down to personal skill based on training and experience, and maybe on intuition. The less time there is left to react, the more it will be likely that interventions will not achieve the intended outcome. Companies that want to improve their management of risks should enhance the possibility for resilience which will optimise uncertainty reduction and successful human intervention. This paper will explain the main characteristics of resilient intervention including: - Scenario thinking - Self-reflection - Learning from failure - Not confusing success with luck (and other cognitive biases) - Paying attention to getting (the little) things right - Stopping and thinking at critical

points - Being thoroughly engaged and vigilant - Multi-perspectives (disciplines and characters)  
- Thinking and deciding together - Tight feedback - Recognising the grey area between normative and reflective responding The paper will conclude on how the reflective human intervention fits into the safety management system, particularly through the management of the delivery systems (procedures, competence, motivation & awareness, communications, availability, conflict resolution, ergonomics, equipment) . Hollnagel, E. Pariès, J., Woods, D.D., Wreathall, J. 2011 Resilience Engineering in Practice. Ashgate Publishing Ltd, UK Resilience Success Consortium, 2014. Success in the face of uncertainty: human resilience and the accident risk bow-tie. <http://www.resiliencesuccessconsortium.com> Van Galen, A. & Bellamy, L.J. (2014) Resilience Case Studies - Dealing with uncertainty in practice: Strengths and traps in human intervention. <http://projects.safera.eu/project/2> and <http://www.resiliencesuccessconsortium.com/resources>

# Achieving better safety at lower cost: good practice for learning with work accidents

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**Keywords:** Organizational learning; Work accidents; Learning practices; Multiple Correspondence Analysis (MCA)

## Abstract

European statistics reveal that work accidents still represent an important social problem for our society and, at the same time, it has been acknowledged the need to use accident information for prevention through learning (e.g., Toft & Reynolds, 1997; Koornneef, 2000; Hovden et al., 2011; Størseth et al., 2012; Jorgensen et al., 2015). Furthermore, it has been strongly recommended that organizations should develop a reporting culture and a learning culture (Reason, 1997). A reporting culture stresses the importance of getting knowledge from small accidents and near misses. A learning culture means that the information is available, disseminated, discussed, and changes are implemented. According to Reason (1997) learning implies a cycle from observing, reflecting, creating to acting. Until now only few studies have focused on the global learning process/cycle (e.g., Koornneef, 2000). Recently, the Institute of Medicine (IOM; 2013) strongly emphasized the role of continuously learning for improving health care in America and simultaneously decrease the costs. Considering the European economic situation it seems also plausible that investing more in learning from accidents can be an excellent way to improve prevention without increasing costs. In the present research the authors combined the organizational learning literature with the safety literature. There are several classical organizational learning theories but it is clear that organizational learning processes may be characterized using two main approaches (Easterby-Smith & Araujo, 1999): technical and social perspectives. The technical perspective stresses the learning requirements (information processing, interpretation and consequences). The social perspective stresses the role of social interaction processes in learning. Together, these two perspectives suggest three key assumptions about what groups need in order to learn from an event: (1) information about the event; (2) opportunity to share points of view about the event; (3) acquisition of new knowledge. Our study aims to increase the understanding about how companies are using occupational accident information and developing strategies and practices for learning with accidents, covering all the learning cycle phases. Seventeen case studies were conducted with Portuguese organizations operating in different activity sectors (e.g., chemical industry; construction; transports; energy production, health care) that were identified as having good practices. The data was collected using long semi-structured interviews with key organizational stakeholders. The interview protocol covered information, such as: type of accident records; existence of a formal procedure for accident investigation; what accident forms are used; procedures used in data collection; procedures used in accident analysis, and finally, how these organizations use the relevant information towards safety learning and improvement. In addition to the interview, relevant organizational documentation was also collected and analyzed (e.g. accident forms, accident analyses procedures, Health & Safety activity reports). All data was subjected to descriptive analysis, followed by a statistical treatment with Multiple Components Analysis (MCA). Multiple Correspondence Analysis allows a multidimensional analysis of categorical variables and it is used to detect underlying structures in a data set by representing data as points in low-dimensional Euclidean spaces. Results from the preliminary descriptive analysis (Silva et al, 2009) suggested that organizations have some standardization of the

practices they use for collecting, coding and analyzing accident information. These formal practices cover the procedures, responsibilities and ways to collect, code, analyze and spread the information about accidents at all hierarchical levels. Simultaneously, it was observed that some (apparently) standardized procedures are characterized by non-standardization. For instance, some organizations accept that accident data might be collected by several persons, with different job responsibilities and training. The present study results, after MCA application, showed two dimensions corresponding to the technical and social learning strategies and practices and four patterns were found. These patterns reveal different levels of learning practices from a level 1 corresponding to minimal practices used for learning to level 4 that reveal a high degree of learning, combining practices with a technical and social nature. Additionally, the results revealed that companies in the same activity sector can have very different practices, independently of the existence of OHSAS certification. For instance, the five construction companies are positioned in all the levels, one company (Construction 1) revealing a low level of learning, complying only to legal requirements, and two companies (Construction 3 and 5) presenting the highest level of learning practices, going far beyond legal requirements. In this paper all these results will be presented and its implications discussed considering the aim of assuring a continuous learning for organizations towards better safety with low costs.

# Research into zero accident vision: success stories from 27 eu companies

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**Keywords:** narratives; successes; vision zero

## Abstract

Introduction The Zero accident vision (ZAV) is a promising new paradigm, which has been developed in industrial practice and offers new perspectives for accident prevention. The basic idea of ZAV is that all (serious) accidents are preventable. In the research project "Success factors for the implementation of the Zero Accident Vision" we aim to better understand the factors and activities that contribute to successful accident prevention in companies that have committed themselves to the Zero Accident Vision. The focus thereby is on four clusters of factors, i.e. commitment to ZAV, safety communication, safety climate, and safety learning. In this paper and presentation we will present the analyses of the success stories of the 27 participating companies. Approach The overall research project into ZAV is carried out in a joint effort of seven research institutes in seven EU countries. 27 companies participated in the study. After a survey focusing on the four main factors mentioned above, qualitative data were gathered in two ways: - Through a limited set of interviews in each of the 27 companies, whereby the focus was on identifying factors that underlie safety successes and challenges. - Through 7 national workshops with the participating companies, wherein the results of the survey were presented and discussed. From a research perspective these workshops were focus groups. The company representatives presented and discussed their efforts towards ZAV including success factors, future challenges, and relevant narratives. This was followed-up by shared reflections and dialogues. Preliminary findings At the moment of submitting the abstract not all 27 sets of interviews and 7 national workshops had taken place; some were still in the planning. As a result, we can only present the preliminary findings here, but at the conference we will be able to present the overall findings. Clearly, zero accidents should serve as an aspirational goal, not a target. There is a need to have clarity in terms of purpose and relevance of safety. Visible top management commitment is a prerequisite. But having defined and communicated safety as company value, or having a clear aspirational safety programme and message can also be of help. As many companies work decentralized, it is essential to achieve a buy-in at local level. Furthermore the 27 success stories helped to identify a limited set of success factors. For the implementation of the zero accident vision. These will be presented at the conference. Examples mentioned so far include: Make safety part of the organizational identity or values Implement multifaceted programs that allow decentralised initiatives Focus on a limited set of key safety risks Create a culture wherein people feel free to discuss safety, also with their superiors. In a positive safety culture people it is appreciated and encouraged when people stimulate each other to improve their safety relevant behavior. Develop and disseminate easy to use tools (e.g. making use of apps for reporting) Challenge people to think for themselves. Ask questions that promote reflection. Avoid pedantic messages. Search and stimulate safety activities and awareness jointly with business partners such as clients, suppliers and contractors.



# Reviewing the value of mandatory certification and testing arrangements for safety in the Netherlands

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**Keywords:** certification; alternatives; review; policies

## Abstract

Introduction The legislation on Safety and health at Work in the European Union is based on the Framework Directive 89/391; in the Netherlands this is translated into the Dutch Working conditions Act. The employers have to take care of occupational safety and health, assess and control the risks, make sure that their employees are knowledgeable about the relevant risks, etc. For a series of activities, there are in the Netherlands complementary requirements for mandatory certification; these concern the competencies of people in high risk jobs (e.g. people working with explosives), the quality and reliability of specific means or tools (e.g. tower cranes), the management of risk control in specific areas (e.g. Asbestos removal), or the quality of Occupational Health and Safety Services. In the period 2009-2012 the Ministry of Social Affairs and Employment renewed the nature of these obligations, with the purposes (1) to get more guarantees that the certification systems work adequately, (b) to make more use of private (market) initiatives and structures around certification and testing, and (3) to be able to reduce their efforts and capacities in this area, limiting their activities to 'having the directors role' for these certification and testing arrangements (leaving the rest to the market). The newly implemented structure, however, leads to several unexpected effects. The ministry is depending significantly on agents they have no control over; some of these agents turn out to miss some of the required competences. The arrangements have become quite complex and there is a threat of more bureaucracy. The relationship of the ministry with the Certification and Testing Bodies has worsened, while the expected improvements in practices are not (yet?) noticed. As a result there is a need for reviewing the (recent) arrangements and especially for simplifying and smoothening the mandatory arrangements, or replacing them by more private arrangements. Against this background, TNO is now carrying out an exploratory research to clarify (1) the added value that mandatory certification and testing arrangement can have in terms of the safety and political value of these arrangements, (2) to identify options to make the system leaner and more flexible, both for the Ministry and for the businesses and individuals involved, without compromising the level of protection. Methodology Data were gathered through brainstorm sessions and interviews with policy makers from the Dutch Ministry of Social Affairs and Employment, interviews were held with representatives from the Dutch Labour Inspection, The Dutch Accreditation Board, the Foundations responsible for the determination of the (draft) requirements for certification, a selection of Certification and Testing Bodies, and from representatives of other Ministries with potentially relevant experiences with high-quality flexible certification systems in other domains. Furthermore a number of formal policy documents were used, as well as a limited selection of scientific papers. These data were analyzed, forming input for intermediary reports to the Ministry. This will be followed-up before summer 2015, by a workshop with experts from the Ministry, and a workshop with the decision makers (directors). Findings and discussion As was expected, the requirements for the certification schemes for products are dominated by European directives; here the only options concern more flexible and harmonized implementation in the Netherlands. For the certification of people and their expertise (e.g. those working with explosives, divers, or operators of tower cranes, as well as safety engineers and occupational hygienists), there are more policy options. What is the rationality to have a legal requirements for a driver's license for the tower crane operator, but not for the drivers of fork trucks? Can the private arrangement for fork lift drivers be copied for the tower crane operator? For the two types of mandatory system certification (concerning the quality of Occupational health and safety services, and asbestos removal firms) there are, in principle, also many policy options. But political factors, such as concerns in the Parliament due to some scandals in the Asbestos sector need to be taken into account. Also changes that built on self-regulation initiatives from the sector can only be successful when there is a high level of acceptance by the sectors and the key actors therein. Furthermore the sector needs to have the

willingness and capacities for such self-regulation, which is certainly not always the case. The requirements for mandatory (legal) certification can be analysed using a variation of the 'layers of protection model'. Purely seen from a safety perspective it may seem at first, that the more requirements for safety the better. However, there is an important parallel with the proliferation of safety rules and regulation: the more rules, the less the added-value of each individual rule. Too many rules and requirements may lead to paper tigers and false safety. We also look forward to discussion with the audience, especially to hear from examples of simple but effective forms of safety certification or registration in other countries.

# Safety rules in the board room: incorporating requirements for senior executives in safety standards

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**Keywords:** rules; senior management; decision making; signature; regulation

## Abstract

It is well established that actions of senior executives are critical for safety and yet there are few rules in place that address their behaviour. Compliance with rules of various kinds (company procedures, standards, regulations) is recognised as a key strategy for safety performance assurance. Analysis of the role of safety rules has focused primarily on technical and operational decisions. One key principle that this work has established is that effective rules vary significantly in the degree of freedom that they give to the user, which must be commensurate with the degree of uncertainty in the activities governed by the rules in order to achieve the best outcome. Goal based rules have the highest degree of freedom, followed by process-based rules, with action/state rules being the most prescriptive. In Australia, as in the UK, safety regulations impose general duties on those in control of hazardous activities. Although the details can vary, such duties typically extend to senior levels of management. These are goal-based rules with only the desired outcome specified – ensuring that risk is reduced to a level that is as low as reasonably practicable and similar - and so provide room for discretion. We contend that, in addition to rules of this type, lessons from past accidents about senior management actions could be effectively incorporated into process-based rules. Process-based rules are often designed to structure communications between people with different expertise to ensure that a diversity of views is included in coming to a particular course of action. Permit to work systems are a typical example. This concept is also very relevant to effective senior management decision making on safety. One of the key organisational causes of the catastrophic San Bruno pipeline rupture was a lack of understanding by those at the highest levels in the operating company involved of the impact of their decision to cut costs. Accidents in other sectors have revealed that a key causal factor is a similar lack of knowledge at senior levels about risks, controls and the impact of their decisions. To illustrate the point, we draw on the case study of the Australian Standard for high pressure hydrocarbon pipelines (AS2885). This Standard is called up in legislation in each state and so has statutory power. In preparing a recent revision to the Standard, the issue of senior management actions to support safety has been specifically considered. As a result, a requirement has been introduced that requires senior level sign off on a small number of key safety documents. Signatories will be signing individually as holders of a specific role, not simply as a representative of their company per se. As Carcello and Li (2013) report, the CFO of a large multinational corporation said publicly of similar new arrangements for approval of financial audit reports, 'I used to sign off in the name of a firm. Now I'm certifying financial statements ... in my personal name. I would like to believe ... that it wouldn't have made a difference, but it does. It is psychologically different.' The revisions to the Standard aim to harness this difference in the interests of long term safety outcomes. Further, we are seeking to include a requirement in the Standard for senior managers to sign a short summary (with a specified content) regarding potential high consequence accidents. The aim is to ensure that those at the highest levels are aware of potential worst case consequences and are not relying solely on advice from technical personnel that risk is at an acceptable level. Overall, these changes have been introduced specifically to improve communication between technical specialists and senior decision makers on significant safety issues. With these measures in place, senior managers will be more mindful of the potential consequences of their decisions. The question has been raised as to whether such procedures increase senior management liability in the event of an accident by introducing more requirements with which they must comply. In fact as described above in many jurisdictions senior managers already have significant (and often personal) liability for safety outcomes as a result of the general duties for which they are responsible. Rather than increasing liability, putting process based rules in place may well allow senior managers to demonstrate appropriate decision making processes, thereby reducing the risk of accident and reducing the chance of prosecution post-accident. Having said that, the proposed changes have met with some resistance and it is instructive to consider why. Internal company rules ultimately

take their authority from senior managers who, in turn, sometimes view rules as a form of command and control management. In this situation, it is hardly surprising that few internal rules apply at senior levels. The paper argues that the main objection to use of rules to promote safe behaviours at a senior executive level comes from such underlying management attitudes to rules in general and concludes that a small number of new process-based rules targeted at senior executives are likely to improve safety.

# Internationalization of domestic transportation systems and safety

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**Keywords:** safety consequences; maritime transportation; increasing internationalization

## Abstract

In this paper, we discuss potential safety consequences of an increasing internationalization of the domestic coastal sea transportation in Norway. The historical development within Norwegian maritime industry will be compared and discussed in relation to other transport systems in Norway, such as long haul transportation and aviation. In addition to discussing the potential safety implications, we will look at the regulatory challenges associated with the increased internationalization. Some questions this paper seeks to answer are: has the safety resources allocated to safety measures been changed as a consequence of the internationalization of transportation system? Has the actual work practices been enhanced or inhibited due to the new situation in transportation industry? During the last decades there has been an increased internationalization of the domestic coastal sea transportation in Norway. A recent estimate made by the Norwegian Seafarers' Union (NSU) is that only 30% of the coastal fleet sails under Norwegian flag. The majority of the vessels sailing with foreign flag are although owned by Norwegian ship owners. These vessels have been flagged out and registered abroad during the last decades. The most frequent foreign flag are among them considered by Transport Workers' Federation (ITF) as "flags of convenience". The use of foreign flag enables i.e. lower wages, longer sailing periods, and less spending on. The vessels are manned mainly by Russian speaking seafarers (Russians, Baltics Russians), Polish, Indians and Filipinos. The flagging out of the domestic coastal fleet echoes in many ways the flagging out of the Norwegian merchant fleet during the 70ties and 80ies. As a response of this process the Norwegian International Ship register (NIS) was established in 1987 as an attempt to counteract the extensive relocation of Norwegian merchant ships to foreign registers and to ensure that Norwegian owned ships were registered under the Norwegian flag. The Norwegian International Ship Register made it possible to employ foreign crew on their homeland's pay conditions. Suddenly, it was made legal to have mixed nationalities on board and thus variations in the wage level and still wear a Norwegian flag. The NIS ships are not allowed to conduct domestic coastal sea transportation in Norway. There are strict rules and regime attached to so-called cabotage, a term that refers to shipping along coastal routes, port to port. Norwegian ships involved in the domestic coastal sea transportation have to be registered in the Norwegian Ordinary Ship Register where Norwegian regulations regarding wage and work conditions had to be followed. However, in contrast to other major shipping nations, Norway does not have regulations that prevent foreign ships to transport passengers or goods along coastal routes. This makes it lucrative for Norwegian ship owners to register their ships in foreign registers, and by this employ foreign crew on their homeland's pay conditions. When the issues are internationalization and shipping, there are similarities with the situation in long-distance transportations and aviation. Although the vessels have been out at the seven seas longer than the Lorries and planes, there are some parallels with what is going on in the cargo freight on the roads and in the air. Aviation industry for example has the last decades experienced a dramatic shift in conditions as company structure, organization of employment and wages issues. Also the long-haul transportation have experienced a new situation characterized by very strong competition from foreign drivers, and very rigid regime when it comes to resting hours and a hard marked situation. Our presentation will mainly be pivoted around the situation the maritime industry, but we will also illustrate this with examples from the aviation and long-haul transportation. Our paper is based on data from several projects the last years, both containing qualitative data from interviews and quantitative findings from surveys.

# Copying the big cat. How the safety management philosophy of one big actor influences an entire industry

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**Keywords:** HSE culture; Translation of ideas; Behavioral based programs; Cultural and holistic approaches

## Abstract

In this paper we discuss how the safety management program of a leading petroleum company spreads throughout the industry and becomes the most “common way of doing things” in the petroleum industry on the Norwegian shelf. In particular we discuss how suppliers adopt or mimic these systems, and how this influences the leverage for other operators. We discuss the disparity between this development and the regulator’s attempts to pursue a culturally oriented philosophy of safety management. The Petroleum Safety Authority (PSA) in Norway states through their framework regulation (§15) that “A sound health, safety and environment culture that includes all phases and activity areas shall be encouraged through continuous work to reduce risk and improve health, safety and the environment” (PSA, 2011). A demand for ‘a culture’ has never before been expressed so directly. ‘Culture’ in itself is a difficult concept to operationalize. PSA suggests in their guidelines to the paragraph that ‘HSE culture can be understood as a culture that enables collective and systematic critical reflection at all levels and cannot be seen separate from other processes in the business’, in other words – a rather holistic approach. This can be understood as the opposite of a compliance approach. PSA gives however no clear definition of HSE culture, and thereby the actors have to contextualize or translate the paragraph into their own company or organization. ‘Translating HSE Culture in the petroleum industry’ (TRACULT ) is a project financed by the Norwegian Research Council. The empirical foundation of this paper is qualitative interviews in eight companies in the petroleum industry; four operators and four contractors. Every actor in the petroleum industry in Norway has over the years conducted HSE activities in order to meet the authority’s demands for ‘a sound HSE culture’. These HSE initiatives have taken the form of HSE program, projects or campaigns. Some of them have been designed in a holistic way, in accordance to PSA’s guidelines, while others have taken form of compliance programs. Some of these HSE culture activities still have a strong holding in the companies, while many has faded away and been replaced by other project, programs or campaigns. Even if there are many significant operators on the Norwegian Shelf, it is one operator that exceeds the others both in activity and size. Since this company is the most influential actor on the Norwegian Shelf, almost every contractor tries to make themselves attractive to this company. As every actor in the petroleum industry in Norway, this big company has conducted extensive HSE activities over the years in order to meet the authority’s demands for ‘a sound HSE culture’. Their latest program focuses on compliance and leadership, is based upon a generic model with intention to operationalize how to control risks in daily work (Kongsvik et. al. 2014/2015), and does therefore not correspond very well with PSA’s guidelines of a holistic approach towards HSE culture. Even so –many contractors lately have adopted the big company’s compliance program in order to be attractive for the big company when it comes to new contracts. Also other small operators seems to adopt the big company’s compliance program in order to be compatible to the contractors they are dependent on, and also because it gives credibility to have the same program as the most significant operator on the Norwegian Shelf. This paper will show how the safety program of a leading petroleum company in Norway spreads out and becomes the most “common way of doing things” throughout a significant part of the petroleum industry on the Norwegian Shelf, despite the authorities guidelines. We suggest that behavioral based programs are easier to copy and mimic than holistic and cultural based approaches. This will be examined by using institutional theory, especially Røvik’s (2007) description on how ideas are contextualized and

decontextualized within the organizations and how ideas are translated in chains between different actors. Also DiMaggio and Powell's (1983) concept mimetic isomorphism, which refers to the tendency to copy successful actors in uncertain times, can be useful when trying to understand how this HSE program has spread throughout the petroleum industry.

# The incidence of chronic venous insufficiency (CVI) in a group of people working in standing or sitting position. The possibilities of prevention CVI at work.

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**Keywords:** chronic venous insufficiency of the lower extremities; occupational factors; standing position at work; sitting position at work; non-occupational factors

## Abstract

Chronic venous insufficiency (CVI) is the most common occlusive vascular disease in people. It is estimated that its incidence among adult Poles varies from 38.33% among men to 50.99% among women. Because of the prevalence, chronic venous insufficiency is considered as a social disease. Annually in the US appears to be on the treatment of CVI to \$ 1 trillion. It has been calculated that the average cost of treating a single patient in US can exceed 40 000 US dollars. Chronic venous insufficiency is a disease that affects people of working age, so be sure to direct costs resulting from its treatment add additional, related to absenteeism. At the same time, type of work, and so prolonged work in standing or sitting, in association with other factors, can lead to symptoms of CVI. Due to the fact that the consequences of a non-diagnosed and untreated chronic venous insufficiency are very serious, and the number of work posts with standing and sitting position continues to increase, undertaking studies concerning the incidence of chronic venous insufficiency among individuals performing work in such conditions and prevention the CVI at work seems justified and up-to-date. The aim of the planned examinations was to evaluate the incidence of chronic venous insufficiency in a group of people performing work in standing and sitting position as well as to determine the influence of occupational and non-occupational factors (lifestyle) on the occurrence of symptoms in the examined group of patients and to . The research was conducted in a group of 500 people who met the following criteria: • age: 25-60 years, • both sexes, • at least 5-years of employment in a job performed in a sitting or standing position (at least 4 hours of work in sitting or standing position daily) The research was conducted with the use of questionnaire study The questionnaire drawn up in the scope of the questionnaire-based study included 69 questions grouped in the following sections: personal data, information on professional work, information on life outside work, questions concerning the state of health. The questionnaire-based study among the employees was conducted using the direct interview technique with the use of categorized PAPI interview (Paper And Pencil Interview) by a research agency. Statistical analysis of the results of research was conducted with the use of a SPSS 15 package. The questionnaire-based study included in total 500 persons, including 238 men (47.6%) and 262 women (52.4%) aged between 25 and 60, on average  $39.75 \pm 10.80$  years. In the examined group of employees, 212 individuals performed work in a sitting position (42.4%). Years of employment in total of the individuals working in sitting position ranged from 5 to 40 years in that group and was on average  $7.71 \pm 9.51$  years. Among the employees performing sedentary work, the desktop computer was used by 80 persons for more than 6 hours per day (37.7%). Insufficient space for comfortable placement of legs under the table-top during work on the computer was notified by 113 individuals (53.3%). Only 50 individuals used a footstool when working on a computer (23.6%). The habit of crossing one's legs when working on a computer or sitting by the desk was admitted by 153 examined individuals (72.2%). In the examined group 288 of examined individuals performed work in a standing position (57.6%). Years of employment in total of the individuals working in standing position ranged from 5 to 35 years in that group and was on average  $14.9 \pm 10.61$  years. The exacerbation of symptoms of chronic venous insufficiency, such as impression of tension and heavy legs, numbness and skin pruritus in the lower extremities at the end of the day, was declared by 260 of the examined individuals (52.0%), after prolonged standing – by 255 individuals (51.0%), after prolonged sitting – by 147 individuals (29.4%), in the summer period – by 193 individuals (38.6%). In 217 individuals (43.4%) admitted that the symptoms of chronic venous insufficiency were alleviated after lifting their legs. Prolonged work in standing or sitting position remains one of the most important risk factors of developing chronic venous insufficiency, that is why it is extremely important to pay special attention to the state of venous vessels in the lower extremities during initial and periodic examinations of persons performing such types of jobs. At the same time, individuals



such types of jobs should be informed of the health effects of prolonged work in standing or sitting position and trained in appropriate preventive actions. The results of the present study indicate a significant association between factors related to the organization of work, such as long-term work in a sitting position, including working with computers, working in a forced position, lifting and /or carrying loads, work involving the use of a large strength of legs and the presence of varicose veins. CVI prevention in the workplace should consider modifying the above-mentioned factors.

# Evaluation of the Danish safety by design in construction framework (SDCF)

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**Keywords:** Construction; health and safety by design; interventions; integrated processes; evaluation

## Abstract

Construction in general is a risky industry also in relation to occupational health and safety (OHS). Annually the Danish construction industry reports more than 5,000 accidents per year corresponding 27 accidents per 1,000 employees. Approximately 700 of these are serious accidents and 10 are fatal. According to a 1991 report from the European Foundation for Improvement and Human rights, deficiencies in design and project planning contribute to a third of the accidents in the construction industry. Correspondingly, a number of scholars has determined that a significant portion of the occupational accidents has root causes in project design and planning. Nevertheless, OHS improvement initiatives in construction often direct their attention to the execution phase. A Danish research project develops and test a framework to integrate OHS considerations in the design and planning of Danish construction projects to achieve a higher level of health and safety in execution. We tested the framework in the design and planning of four construction projects. This paper analyses the results of the interventions. The Safety by Design in Construction Framework (SDCF) couples OHS risks to the stages and processes in design, engineering and planning and applies a holistic approach to OHS including both safety, health and mental health. The developed written material guides the stakeholders through the different design stages and gives examples and inspiration on what, why, when and how to design for safety. In particular, the SDCF emphasise a focus on the process conditions in execution in relation to OHS. The intervention process mainly address designers, engineers and clients on the projects and includes workshops, interviews and interactions with participants in design and project planning on four construction projects. The evaluation combines quantitative and qualitative elements and consists of process evaluation and ex-post evaluation of the effects at the completion of the project design and planning. The process evaluation consists of continuous observations and participation throughout the design and planning stages while the ex-post evaluation combines questionnaires and semi-structured interviews with the involved stakeholders on the projects. I.e. each design process concludes with a review and an analysis of the intervention process and the results. Results are mixed. In two out of four projects, effects can be documented while in the two other projects none or only minor effects can be documented. However, valuable knowledge on the process of integration and implementation was gathered. In the two successful interventions, the process evaluation reveals a number of examples of specific decisions and solutions made because of the SDCF intervention and the specific focus on enhancing OHS in execution through safe design. Examples are the holistic planning of a large atrium that combines 1) a change in design of solutions e.g. the design of the skylights and temporary safety railings with 2) considerations on the processes and a holistic view on needs for scaffolding throughout the construction period. Initially the designers expected to do the planning of safety precautions after the design and separated from design decisions. Other examples are the design and planning of cabling above a suspended ceiling where the designers because of the SDCF plan the cable routing to minimise attrition in the comprehensive amount of work with arms raised above the shoulders. Similar examples are present in relation to dust, noise, vibrations, chemicals, manual handling, harmful and/or hazardous working positions etc. Another effect of the SDCF in design and planning is the enhanced focus on buildability and execution processes e.g. adjusting schedules and workspaces to ensure unwanted OHS risks and exposures and incorporating constraints and interface between different stakeholders and professions in execution. The findings suggest that organisations can implement the framework successfully and the evaluation hints that the small usages of extra resources in the intervention projects is due to the learning process rather than the actual application of the framework. However, a number of challenges occurred especially in the establishment of the intervention process and establishing the incentives and

focus for the stakeholders to prioritize an OHS effort in design and planning. In the successful interventions, we successfully established involvement, focus and prioritization in the project group already in the early design phases and as a result, the SDCF integration was successfully integrated with the core activities in design and project planning. Hence, integration with existing practices is a key explanation to the difference between the successful and unsuccessful interventions and the success of this integration depends on the support of central stakeholders (companies, clients, project managers etc.), and continuous perseverance and dialog/feedback. A final important prerequisite for the intervention to be successful is early involvement: Already in the preparation and brief, the client visions for the construction project should include a vision for occupational health and safety, quality and cooperation between the stakeholders. We conduct the questionnaires and interviews for the ex-post evaluation in the spring of 2015 and adjust the framework materials according to the experiences from the intervention projects. The results is included in the conference presentation and final paper. Moreover, the paper suggest a number of focus points for future research including testing the framework on a greater number of projects and across a greater variety of project types and sizes.

# Regulatory discourses about regulation and the regulated

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**Keywords:** Regulation; regulated; regulatory discourses

## Abstract

For foreigners it may be difficult to understand how the regulatory framework for health, safety and environment (HSE) in the Norwegian petroleum industry works (Lindøe, Baram & Renn, 2014). From a legal and economic perspective (Baldwin, Cave and Judge, 2010), it may seem that the rules are too imprecise, that the authorities conduct too few inspections, and that the authorities are using too "soft" forms of reactions in case of violations. The Petroleum Safety Authority (PSA) follows up cooperation between workers and management at the individual workplace, and they help to promote tripartite collaboration between employers, workers and authorities through various collaborative arenas. The PSA conducts system-oriented and dialogue-based supervision and emphasizes that it is the companies' own responsibility to monitor that they comply with laws and regulations. The PSA has explored synergies between corporate governance and HSE regulation in order to promote incentives for good safety work that go beyond the threat of regulatory sanctions in case of violations (Rosness et al., 2008). The PSA has also recognised that new regulatory approaches are needed to stimulate the regulated organisations to ensure favourable environmental conditions for safety work for their own employees and contractors. These examples go beyond the catalogue of regulatory strategies proposed by Baldwin, Cave and Judge (2010) in their textbook on regulation. We suggest that reliance on regulatory strategies that go beyond compliance monitoring and enforcement may be a vital aspect of the Norwegian model of tripartite collaboration. However, contextual changes such as cultural and ideological changes, or the entrance of new players into the Norwegian petroleum industry might create a pressure towards increased focus on compliance. Compliance monitoring and enforcement are highly salient and explicit aspects of regulation. A Norwegian White Paper on regulation states, for instance, that "The core of the regulatory role ("tilsynsrollen") is, however, the concrete control of the duty holders' compliance with a norm that has already been stipulated by law, regulations or individual decisions and reactions in case of non-conformance" (St.meld. nr. 17, 2002-2003, p. 22). Other aspects of the regulatory role tend to be less formalised, less explicit and less salient. This leads to a concern that the salience of compliance and enforcement in regulatory action may have unintended effects on the interaction between regulators and the regulated companies (Wilpert, 2008), and that it may lead companies to focus excessively on compliance in their safety management efforts, and thus may divert attention and resources from alternative safety management approaches, such as attempts to build resilience (Grøtan and Størseth, 2011) or efforts to ensure favourable environmental conditions for safety work (Rosness, Forseth and Wærø, 2013). Based on this, we ask: 1. In what way, do the PSA focus their supervision in accordance with this philosophy? 2. What about compliance within such a framework? 3. What do informants in the PSA see as challenges to this way of regulation and conducting audits under pressure? The main focus of the analysis will be to look for distinct discourses about (1) the nature of HSE, HSE work, HSE problems at the company level, and (2) the appropriate regulatory strategies, including the use of sanctions. Is it, for instance, possible to identify a distinct "sociotechnical discourse", an "engineering discourse" or a "juridical discourse"? Are there links between how informants conceptualise HSE issues at the company level and their positions with regard to regulatory strategies? We will pay particular attention to the way informants comment on the interactions that occur in encounters between regulators and the regulated, for instance related to audits. To answer the research questions, we will re-analyse data material from the work of an expert committee appointed by the Norwegian Ministry of Labour (Engen et al. 2013). The design of the study was qualitative, and the data material consists of 33 focus group interviews with a total number of 89 informants. The data collection was carried out from March to June 2013. A follow up study with three focus group interviews where accomplished in the PSA in May/June 2014 mapping the PSA inspector strategies concerning risk exposed companies in petroleum related activities, and viewpoints from key informants in the PSA. In this paper, we will mainly concentrate on the strategic selection of

informants in the PSA. We will pursue an inductive and stepwise approach in the data analysis in order to generate concepts and identify discourses. Possible tensions between and within the discourses identified will be discussed. Whereas a high degree of consistency in the reactions from a regulator may be desired from a juridical point of view, some diversity might be seen as potentially valuable from other perspectives, as this might help to maintain a richer repertoire of interpretations and strategies in the regulated companies.

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# Arguments and drives to change your safety culture

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**Keywords:** survey; culture; change; arguments

## Abstract

Nowadays companies from several industrial areas are starting safety culture programs. These programs consists of a variety of methods and implementation strategies, depending on needs, size and companies' budgets. AdviSafe risk management emphasizes the importance of improving safety culture in order to optimize the effectiveness of control measures. AdviSafe's safety culture approach starts by strengthening safety leadership at management level. These activities provide insight into the role that management can play, how (personal) commitment can be shown as well as enabling the determination of the organisational ambition. Awareness of safety leadership combined with actively involved employees creates maximum commitment from the organisation and has proven to be successful. We support in our research and consultancy practice a diversity of companies to strengthen their safety culture. This support varies from research into practice, but can also consists of workshops on several organisational levels and on several topics. Although we consider a variety of such programs are available to start up activities on a company level, for example the Hearts & Minds program of the Energy Institute, we found that these programs do not meet at all times companies' needs. We therefore raised the question why and with what perspective in mind, companies are starting safety culture programs. What are true arguments? Is safety culture the real issue or are more general chance management questions the leading issue? And, what are the real KPI's for starting a safety culture program? And if so, what is the effect of these arguments to their actual safety culture? We addressed these questions to look into the daily practice of five companies from different industries. To get an impression of the current safety climate at the companies and to discover not only possible elements for improvement but also get an impression of the arguments to strengthen company's safety culture , we used a qualitative bottom up method, including 11 (safety) culture topics to collect data from interviews and document analyses in companies. These topics are: leadership and management (is management always committed to safety); quality and quantity of procedures (quantity and quality of existing HSEQ procedures); daily HSE behaviour (Do you always work safe? Is it always possible to work safe?); competences and safety awareness (what are the hazards and risks); contractor safety (cooperation with contractors regarding to HSE); reporting incidents (do employees feel free to report all incidents); continuous improvements (is the impression that the company is focused on continuous improvement? How? Are there examples available?); involvement of employees (are employees involved in safety initiatives, examples); communication (is safety vision consequently communicated); maintenance management and management of change (what is the quality of maintenance and are HSE issues always considered in cases of change) and risk management, meaning are all risks sufficiently known and tackled? In our presentation we will reflect on the question of leading arguments for starting a safety culture program using models from chance management literature (e.g. Kotter, 2007 and Cozijnsen 2014) compared to the data and practical experiences with safety culture programs of five companies.

# The role of leadership for a better safety performance in multilingual organizations

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**Keywords:** migrants; leadership; safety performance; multilingual teams; safety culture

## Abstract

Objective Existing approaches to stimulate safe behaviour mostly fail to devote explicit attention to the diversity of employers on the workforce. Especially the group of workers that performs risky and low skilled work appears to be more diverse in terms of age, language, culture, religion, gender, and also health status. In this study we focus on the improvement of safety performance in multilingual i.e. multicultural organisations. Due to globalisation trends the need for tools that pay attention to language issues and aspects of cultural background for the prevention of accidents has grown. One of such tools could be the managing role of the leader in such diverse teams as is already shown by the positive effects of a Safety Specific Transformational Leader (SSTL) on Safety Performance on operational workfloors. The open and safety specific style of communication of this type of leaders has been shown to foster safety on the workforce. However, none of these studies made a comparison between multilingual and monolingual work teams regarding the effectiveness of this SSTL communication style. One could suggest that in multilingual teams a “walking and talking around” manager is not that profitable as in monolingual teams; in what way he manager has to communicate with his colleagues speaking different languages in order to be convincing about safety performance? To explore the safety performance in multicultural teams and the role of leadership, we defined the following research questions: (a) do multilingual organisations differ in safety performance from monolingual organisations? (b) what is the impact of leadership to safety performance, and does this differ between monolingual and multilingual organisations? (c) What do our findings mean for potential approaches in managing safety of multilingual organisations? Methods: Based on a questionnaire study in 17 companies in the warehouse sector in the Netherlands (the total number of participants was 260, from which 154 from multilingual organisations), we have analyzed the following variables: company safety awareness, personal safety awareness, general safety risks, safety-specific transformational leadership. Pearson correlations, a t-test, linear regression analyses and an interaction term were conducted to test the relations and differences between the relationships. At last the results will be discussed with a selection of the companies in an interactive panel with experts and practitioners. Results: Our first analyses indicate that employees in multilingual organisations show a lower safety awareness on company level, more safety risks and a lower score on transformational leadership. Also, it shows that transformational leadership is positively related to safety awareness and negatively to safety risks. The results of explorative multivariate regression analyses indicate that there is a positive relation between leadership and safety awareness on a company level and a stronger relationship between leadership and safety awareness in monolingual organisations compared to multilingual organizations. Conclusion: The results of this study show that the safety performance within multilingual organisations is lower than the safety performance of monolingual organisations. Also we found that there is more transformational leadership in monolingual teams, and also that the relationship between leadership and safety is stronger in the monolingual teams. We will discuss these outcomes with a selection of the involved companies to make recommendations on how to improve safety performance in multicultural organisations. The involvement of the companies self is important since culture is a very complex phenomenon which makes it very important to look at the contextvariables as well before drawing conclusions.

# **Violent management and organizational pathology. Reflections for an intervention articulated between academia, services and unions.**

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## **Abstract**

**Introduction:** The management of the workplace is increasingly characterized by competitive business strategies with a view to increasing the extraction of profit, increase productivity and capture the "soul" - the subjectivity of the workers. Increasingly aggressive, it is making the workplace a pathological field with disease epidemics of the psychic apparatus (depression, burnout, suicide attempts, panic attacks, among others). These ailments are growing in importance and coexist with conventional injuries and diseases such as those of the musculoskeletal system, typical accidents, cases of contamination etc. This attempt to capture the individual and collective subjectivity of the workers is not, however, taking place without meeting any resistance - whether manifest or latent. A joint confrontation on the part of academics, workers' health services and the union movement by means of a common agenda can open the way to initiatives of intervention and transformation. **Objectives:** to describe and analyze aspects of the organization of work as experienced by the participants in a National Workshop and a Diffusion Course promoted by the Work Accidents Forum held between August and November 2014, so as to reflect and illuminate future paths to be followed together. **Method:** On the basis of an open course and a national workshop held with union leaders in 2014, this paper reports on and discusses aspects of the above-mentioned organizational pathology. The meetings were recorded, transcribed or noted with the authorization of the participants. The contents of the speeches and the dynamic of the two events were analyzed with special emphasis on the present forms of work management which emerged very strongly at both events and which appear to lie behind the modalities of the harmfulness present in contemporary work contexts. **Results:** Work management, by virtue of its violence, presents even more perverse nuances in the way in which the companies manage lay-offs by reason of workers' inability to carry out the work arising from the occupational diseases and work accidents. In the specific case of a woman worker, the pressure imposed by management strategies, determining speed and targets, led her incessantly to seek to exceed the full capacity and limits of her own body. This was the rule imposed to obtain recognition as an efficient worker, which should diminish, therefore, the risk of unemployment, but was also the cause of her falling ill, culminating in her inability to do the work and the decision to amputate her own arm, such was the intensity of the pain arising from a musculo-skeletal lesion. In the banking sector, the environment is extremely competitive – between personnel, teams and service units – used to transform promotion and reaching high positions, into a seductive objective. The recognition, which might be financial, moral or both, had to be conquered at any price, even though it led to the relegation of the family to second place, and to the adoption of unhealthy habits and the privation of sleep. The illusion of professional and financial stability inspired the decision to leave aside formerly important values such as the family in the quest for progress within the firm. The fetish of professional advancement, with better salaries and greater responsibilities led a woman bank teller, then situated in a high position in the hierarchy (superintendent), into a state of anxiety, accompanied by an increase in weight and estrangement from the family. However, when the worker's physical and psychological limit had been reached, the woman who attained targets, took over branches and grew in stature in the company came to be an embarrassment to the achievement of its objectives. As she had



ceased to be productive and no longer generated profit, the professional became disposable, and was rapidly replaced by another manager. In the electrical sector, the encouragement of outsourcing and to the reduction of the work-force brought tragic consequences to the workers concerned. The main of these was the increase in work load and density, with a considerable increase in risk. The death of a colleague brought a sense of insecurity to the work team which had, up to that point, believed in the company when it said that despite their working with a live line the procedures adopted guaranteed their safety. As for the manual harvesting of sugarcane, the managers of the sugar and alcohol sector based their workers' payment on productivity, a managerial tactic which encouraged the individual quest for increased productivity. To encourage competition, the managers hired a faster worker and with greater cane-cutting capacity, called a "rabbit" ("coelho"), as a means of stimulating competition among the workers. These facts generate concern among union leaders who report on the difficulty faced by any possible union action, seeing that the management system which adopts the principle of payment for productivity induces the workers to produce beyond their physiological possibilities with the legitimate objective of increasing their remuneration. Conclusions: The reports, especially those of bank workers, point to the new modality of more impersonal, more aggressive and merciless management as productivist "terrorism" which does not spare even the high positions in the hierarchy. This violent character seems to differ from the business strategies adopted at the beginning of the period of globalization, when gentler and more subtle strategies were used for the purpose of integrating the worker into the company's objectives. Responding to this complex and multifaceted objective calls for collective, trans sectorial, multidisciplinary strategies which require new concepts, new tools, new methods of diagnosis and intervention allied to the strengthening of the subjects involved and the community. Based on the experience of the worker's health movement of Piracicaba-SP, this article discusses the importance of coordinated actions of research and intervention, involving the actors of the three poles: academia, organized workers' representatives and public officials of Worker's Health services. These joint actions appear to be indispensable to throw light on the challenges and to intervene in the normally invisible organizational determinations of public agents.

# In search of organizational analysis: a road bridge collapses while under construction in the interior of the state of São Paulo/Brazil

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**Keywords:** Work accidents; civil engineering; organizational approach; prevention; worker's health

## Abstract

Brazil has been making large investments in infrastructure projects as part of its Growing Acceleration Program, especially in the expansion of ports, airports and road systems favoring urban mobility. It has held major events such as the 2014 FIFA World Cup and will be hosting the Olympic Games in 2016. Work accidents are complex phenomena that occur as a result of synergies between various factors within socio-technical systems. It is, therefore, important to investigate and identify their underlying causes. In July 2013 ten laborers were the victims of a work-accident while working on the construction of the southern section of a road-bridge over the Piracicaba River located in the interior of São Paulo State. Of those workers, 5 were seriously injured and 5 others died. The construction was being undertaken by an outsourced company responsible for the whole process, including the hiring of the workforce and the operational services. The activity consisted in the placing of the last pre-fabricated iron-concrete beam (weighing about 80 tons) on the support of two transversal beams by a crane (called a "shuttle trellis") to complete the bridge's south lane. The team hired to place the beams undertook the placing of the penultimate one between the supports nº 4 and nº 5 of the respective transversal beams. They moved the shuttle trellis to permit the loading of another beam stored on the right bank of the river, later to be placed between supports nº 4 and nº 5. While the part referred to was being put in place, the structure of the central pillar ruptured followed by the collapse of all the supporting structures, including the cross beam and the shoring system (used for its concreting), leading to the collapse of the nine beams already in place, as well as the fall of the shuttle trellis. This event led to the fall of the 10 workers who participated in the operation. The episode was analyzed by experts of the Scientific Investigation Division of the Brazilian police and the Technological Research Institute and was also discussed at the Permanent Regional Construction Committee meeting at Piracicaba City. The objective of this study will consist of a re-examination of the analysis of the reports made by those entities and discuss the results based on the Analysis and Prevention of the Work Accident Model (MAPA) and the approach of organizational analysis inspired by Michel Llory's studies. First Results: The main results of the analysis made by those entities indicated: failure in the execution of components not included in the bridge's original project; the basis of the slieve of the caisson was resting on rock differently from the project; the thickness of the slieve of the central caisson was also different from that specified in the project; the nucleus of the central caisson was of smaller dimension than that specified in the project, meaning that there was a greater load concentration on the nucleus than was foreseen in the bridge's project; there was a lack of support in the metal armature of the central caisson differently from that foreseen in the project; the perimeter of the nucleus of the caisson was partly without the metallic armature in disagreement with that foreseen in the project; lack of any armature of the nucleus executed in the region of the transpass of smaller dimensions than that specified; process of the concreting of the shaft had been interrupted; lack of any indication of the thickness of the slieve of the central caisson; conflicting indications of the quota support of the widened base of the

central caisson in the drawings of the bridge project; insufficient technical information and orientation for the execution of the process of solidification of the concrete parts; lack of physical inspection and management system of the concreting processes; lack of communication between the process management sector and the safety and health management system; quality control failure; execution and inspection wrongly understood as an exclusive assignment of the outsourced company hired; lack of communication within the framework of the teams' technical and operational processes at the specific moments of switching shifts; high rates of turnover; pressure for increased productivity; lack of previous analysis and preventive actions for a high-risk operation; ineffective control of occupational risks; working method divergent from standards of work safety; inappropriate working place; absence of further investigation of a previous accident on another section of the same construction, including a lack of inspection of the components used. Discussion: The results pointed to a non-ranked list of failures suggesting that all of them contributed jointly to the final result. The above list consisted of technical and administrative failures without suggesting any possible relationship between them, which makes the understanding of their organizational origins difficult. It is necessary to ask the following questions to broaden this analysis: why did the company not obey the project? On what terms were the workers hired and how were the contracts made? Was the project design completed? How and by whom was the construction project managed? Why was the quality control audit undertaken by the same company when in similar situations an external audit (made by an independent, unrelated company) is called for? The answers to these questions are indispensable if one wishes to bring the hidden failings, the inconsistencies leading to the appearance of the anomalies and failures observed in this system, to light and clarify them. For this approach it is crucial to know the day-to-day work routine at the construction site, its context, the pressures that affected the workers, the company's history, contract conditions, production and security management, the project management, supply management, as well as the public surveillance and prevention agencies. This study is in its initial stage and will contribute to improving the professional vision of work-related accidents and also disseminate the organizational approach and help in the elaboration of public prevention strategies. This investigation is part of the project: "Work Accidents: from socio-technical analysis towards social construction of changes" FAPESP 2012/04721-1.

# Evaluation of the biosafety and the physical structure in dental clinic of a public school in the city of Curitiba

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**Keywords:** contamination; biosecurity; occupational hazards

## Abstract

During his labor activity the dentist is exposed to various risk factors and also exposes their patients. This research focused on analyzing the risks relating to the physical structure and aimed to evaluate the physical structure of the dental clinic of a public school in the city of Curitiba, Brazil, and its impact on biosecurity. A descriptive survey was conducted in October 2014, through direct observation of architecture and furniture of two dentist's offices in accordance with Resolution 50, year 2002, standard of National Health Surveillance Agency (ANVISA RDC no. 50/02) and the standart of Support System for Investment Project Development in Health (SOMASUS). We carried out a photographic record for risk analysis, documenting possible information sources and existing control measures. As to the physical building structure it was found that the architectural requirements were followed in a few points as, offices have the area of 22 square meters higher than the minimum set which is nine square meters, with no apparent pipes in walls and ceilings; waiting room for patients; a bench with separate sinks for hand washing and materials, and autoclave for sterilizing instruments. The light-colored walls were coated with paint resistant to washing and cleaning products; floor of ceramic in the offices and grout with water absorption rate of less than 4%; natural and artificial ventilation and filter changes every six months. However, inadequacies were also found: floor of the waiting room was old, worn and parquet, many of these parquet flooring spoiled and some loose allowing accumulation of dirt around and below them; irregular footers to the wall and the floor, which do not allow proper cleaning and sanitizing the corner formed; an office without protection against the incidence of sunlight, causing glare in working routine during the morning hours; taps that had no device to dispense contact with hands; brushing room with rotting baseboards because of moisture; tiled walls until the middle and inadequate painting showing infiltration in the rest of the space. As to the furniture, the offices have dental set, dental x-ray machine, cupboard, cylindrical bucket door with debris pedal, rotating chair / stool, chairs, table type office with drawers, swivel chair with arm, all well distributed in an area of 22 sqm, according to what advocates the rule of SOMASUS. The study enabled us to identify the potential risks of contamination of this sector, especially in relation to the built environment (architecture). Thus, we conclude that the practices analyzed in infrastructure criteria, are at odds in the ANVISA RDC no. 50/02. The fact conform to the flow of aseptic procedures, follow the safety standards and health, according to Regulatory Standard no. 32 (NR32), and have adequate furniture, does not guarantee effective security in the control of cross-contamination because of inadequate infrastructure present in some sectors, requiring reforms in physical spaces and adaptations in dental clinic that conducive to the elimination of contamination risks and safeguarding the health of workers and patients to be assisted. It is necessary commitment of the institution and its employees for the spaces and practices meet the necessary requirements to minimize occupational hazards.

# Workers' health as safety tool at work: anti-smoking treatment analysis in police force

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**Keywords:** Smoking; health and quality of life; neural stimulation

## Abstract

Police work has many hazards, and in order to minimize many of them, particularly those relating to personal accidents that endanger the integrity of this worker, it is necessary to maintain a good cardio-respiratory condition. Many factors may affect this condition, and among them we highlight sedentary lifestyle and smoking. About the smoking, focus of this study, epidemiological studies in Brazil have shown that respiratory diseases has been occupying an important place in the main causes of hospitalization in the Unified Health System (SUS) and that the prevalence of chronic bronchitis, wheezing and breathlessness are more common in smokers, with a prevalence rate in direct proportion to the number of cigarettes smoked. It is estimated that 50% of smokers will develop chronic bronchitis and even those who do not yet have clinical symptoms already have functional and morphological changes in the lungs. From the point of view of workers' health, studies have also pointed out that smoking cessation improves respiratory symptoms as much as the decline in lung function and bronchial hyper responsiveness. So it is relevant to adopt worker's healthcare policies that focus on reducing the prevalence of smoking. However, despite the various techniques described in literature, there is no consensus on the best strategy to achieve this goal. So, this article aims to investigate effectiveness of non-pharmacological treatment strategy, known as Neural Stimulation (NE) in a Brazilian military corporation in southern Brazil. For this purpose has been performed an exploratory and descriptive research with 27 workers who were smokers and were willing to quit smoking. The technique of NE was first presented to all police through speeches conducted by a group of volunteers from a non-governmental organization (NGO). After raising awareness through lectures, the group that agreed stop smoking went through a course that taught the technique that should be applied on a daily basis. For monitoring the effect of treatment researchers adopted a monoximeter to evaluate treatment six steps. The equipment measures the CO concentration in parts per million (ppm) on a scale ranging from 1 ppm (non-smoker) to 20 ppm (heavy smoker). When arriving to the course on the first day the worker has been evaluated (average of 9,3ppm), ranking the group on the penultimate level of light smokers); during the course after smoking his "last cigarette" (average of 11.1 ppm); after the first week of self-treatment (average of 3,3ppm); after the second week of self-treatment (average of 3.0 ppm); after three months from the starting of self-treatment (average of 6,6ppm) and after six months of starting self-treatment (average of 6,5ppm - first level of light smokers). At the end of the study, none of the military stopped smoking, although there was a reduction of two levels in the monitoring range. This result showed a tendency to decrease or cessation of smoking during the two weeks in which volunteers of NGOs and researchers were in the corporation. Direct stimulating and supporting during the beginning of self-treatment appears to have presented a positive result. However, with the gaps between meetings, there has been hard to maintain the motivation to quit smoking, as demonstrated by reports where only one of the military have performed the technique of NE every day as recommended. Therefore, so that strategies like this are adopted in other companies, it is suggested that you keep a support group until the end of the recommended time for smoking cessation and besides monoximeter, cardio-respiratory fitness tests to be applied so that participants can clearly quantify the benefits of to kick the habit.

# Intervention report in a mining company in Brazil

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**Keywords:** Work safety; Environment; Training

## Abstract

The practice that will be presented below took place in May 2014 and was held in the National Forest of Carajás, in the state of Pará in Brazil. The intervention was hired by a company which extracts mineral resources in Brazil. The company Comportamento has been developing consultancy work in this mining company since 2012, when a climate and safety culture survey was performed. The result of the survey indicated a gap between the theory and both the practice of the tools which should ensure safety and the actions of company leaders focused on security. Therefore, reformulations and training actions were suggested in security tools such as Security Dialogue, Behavioral Approach (Geller's COACH method) and coaching activities with managers. The mining company has administrative and production sites in different parts of Brazil, but the actions described here were carried out only in the administrative unit in the state of Minas Gerais. After the implementation of the action plan, the consultancy company felt the need to assess on site how the dissemination of this training programme was as well as the changes in patterns in the operational areas. It was in this context that the interventions occurred in Pará, in a forest land that has much of its extension preserved by a national park. In this area, coexist the mining workers, the indigenous lands preserved by the National Indian Foundation (FUNAI) and the villages and towns that grew in the surroundings due to the offer of employment in the region. The work consisted in the observation of the professionals in the area of security as well as the company's and contractors' leadership staff for a period of 10 days, in their day to day work, talking about and observing how the tools and training which had been given in the administrative unit in the state of Minas Gerais were being applied. The first point observed is related to the environmental impact caused by the mining company. Acres of native forest land are devastated to facilitate the extraction of ore in open pit mines. The second point is related to the safety of the working environment, since the observed activities are carried out in the natural environment with the possibility of interference by factors which are hard to control such as weather, rugged terrain and the appearance of wild animals like jaguars, scorpions, snakes etc. Regarding the environmental impacts, there is in Brazil a regulatory body to which the mining company needs to report and request authorization to extract from the soil, which is the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA). Therefore, all the area in possession of the mining company for soil extraction was approved by such law-enforcement agency, which constantly conducts audits to verify that the right conditions are being met. Another point observed is that there are certain requirements for IBAMA to grant the right over land to the mining company, two of which are: previous environmental mapping of all local fauna and flora to be mined and areas of compensation, that is, upon receiving authorization for an area, the company has to undertake to preserve another of the same environmental value. With respect to workplace health and safety, mineral reserve drilling activities, cave mapping and placement of explosives for blasting the ground were observed. The main point found in these observations was understanding the challenge encountered by the workers every day to adapt the security procedures to a natural environment. Personal Protective Equipment, for example, commonly used in factories had to be adapted from sports activities such as climbing boots to meet the need of cavers in long forest walks and the use of special glasses and overalls which did not fog up nor impede ventilation, in the case of clothing, due to high temperatures and humidity of the forest. In what concerns the tools trained by the Comportamento company, it was noticed that in practice they were being carried out, but with the necessary adaptations needed by the workplace, which did not prevent the quality of their execution. As for the performance of the leadership staff, it was noticed the development of informal leaders, especially in places where the official position of formal leadership was located in the head office in Minas Gerais. It was noticed how technology is being used to help prevent accidents such as the use of equipment that measures the incidence of lightning and storms, common in the local weather. Finally, when analyzing the accident rates on site it was found that the rate of accidents with first aid care decreased from 2013 to 2014. Experience has shown that it is possible to develop work intervention in remote areas as long as the specificities of the workplace are taken into account, since the workers

themselves end up making these adjustments. In addition, the findings reinforced what had been found in several studies about the role of the leader in the workplace. The interface between the environment and safe working conditions has been a subject of discussion in Brazil, since the traditional security practices which demanded only the use of Personal Protective Equipment, are being replaced by an approach focusing on the effects of the behavior of the leadership staff and the use of technology, a priority in a country which relies on commodities as its major export good for the world.

# Changes in the patterns of the hazardous protective suits: a necessary measure to prevent accidents

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**Keywords:** CBRN coverall; Fabric toughness; Tears in seams; Puncture resistance; Emergency response teams

## Abstract

**Introduction** In recent years there has been an important increase in the number of interventions in Madrid, involving medical emergency workers, associated with chemical and biological risk. In those interventions, the safety of the workers depends, among other things, on the integrity of the protective suit [1]. At the end of 2014, the occupational accidents within the health workers who attended ebola-infected patients stood out the significance of a correct selection of the protection equipment. Apart from hazardous risks that make essential the use of protective suits [2], the working environment for emergency services teams might have hook and sharp elements (collapsing buildings, needles, street furniture, vegetation,...) threatening the suit integrity. During learning courses, practices and real interventions, we have observed some tears in the perineal zone seams, which led us to study the factors influencing on those dangerous fails. We tested [1] protective suits with hood, made with a microporous membrane and classified as Category III protective equipment with limited protection against particles (type 5) and limited liquid splashes or sprays (type 6). **Study overview** The main findings of this study were obtained by performing a cross-sectional study: the sample underwent a stress test regarding their physical features (flex cracking resistance, tensile strength and puncture resistance) [1]. The convenience sample consisted of 45 members of SAMUR-PC-Madrid (civil protection and emergency medical service agency), who had basic training in wearing CBRN suits for hazardous risks, being 62.2% of them members of HazMat teams. They wore a XXL-coverall (the biggest size). The suit was sealed in wrists with the gloves and in calves with the boots. All of them completed a four tests circuit: bending over to pick up an object from the floor, getting on a 60cm. high object, walking 100m. and crossing twice a narrow pass (about 10cm. bigger than the intervenient) with sharp elements (in one side of the pass there were 15 mm. sharp elements linearly aligned between 0.30 and 1.50 meters from the ground and, in the other side, 6 mm. sharp elements randomly distributed and connected by a wire). The average morphology of the participants was: a male, 31 years old, measuring: height 171.73cm. (SD=9.42, 95%CI=169-174.5), chest circumference 98.8cm. (P25=88, P50=98, P75=108.5) and waist circumference 90.16 cm. (P25=76, P50=84, P75=103) and L-size according to manufacturer specifications [3,4]. **Results** 33.33% (16) of the coveralls got broken at the seams. Within them, 75% (12) the tears were situated at the perineal zone, while 66.66% (16) of the tears happened in overalls whose size was bigger than that recommended by the manufacturer. The average waist measurement of the people, who tore the coverall at the perineal seams, is 113.6 (SD=14.8, 95%CI=104.87-122.37) and the average person would use XL-size according to manufacturer specification and was using XXL while performing the test. The study has revealed a lack of toughness of the fabric at the seams (which are the most critical areas), mainly at the perineal zone (with higher prevalence in men). The tears were produced even when using bigger than recommended sized coveralls (the recommendations are based on height and chest circumference). According to recent studies, the average waist circumference of Spanish people is increasing. This fact augments the multidirectional tension in the perineal zone, thus subjecting the fabric and seams to an increased effort compared to which they were



subjected several years ago, when these suits were designed. 55.56% (25) of the suits presents orifices, within them 52% (13, 7 men and 6 women) were situated in the back, 48% (12, 9 women and 3 men) in the lower limbs, 32% (8, 5 men and 3 women) in the abdomen and 36% (9, 5 men and 4 women) in the thorax. The average height for the 12 people whose suit presented orifices in the lower limbs was 167.25cm. (P25=160, P50=165, P75=169.5) and their average manufacturer recommended size was M. The study shows two noticeable differences between the damaged zones: one depending on the difference between recommended by the manufacturer and used size and the other depending on the participant gender (lower limbs in women and abdomen in men). An additional problem is that, due to their location, some of the tears were not detected when they occurred. Conclusions The pattern design should start adapting to the new anthropometric measures of the current population and with variation between men and women. As sizes are getting increased, waist and hips circumferences of the protective suit should be increased at a higher rate than the other measures or included elastic elements. The perineal zone of the protective suits must be reinforced, especially at the seams. The measures to choose the correct size, in the manufacturer specifications, must include the waist circumference. Damages in lower limbs appear with a higher prevalence in women as they have a lower average height, thus causing bags which are at greater risk of being punctured. To get a better adjustment to the various anthropometric measures it would be advisable to implement tightening elements to better fit the suit to the worker phenotype, particularly in the back and under the buttocks. All these measures are aimed at obtaining a further adaptation of the suits to the actual worker constitution, thus minimizing the risk of accidents. References [1] Schwope, A.D., T.R. Carroll, J.O. Stull, M.D. Royer, "The selection and measurement of physical properties for characterization of chemical protective clothing materials", Chemical protective clothing performance in chemical emergency response, ASTM-STP 1037, Perkins, Stull editors, American Society for Testing and Materials, Philadelphia, 1989. [2] Giménez-Mediavilla, J.J., Castillo-Ruiz de Apodaca, M.C., González-Rodríguez, D., "Actuación sanitaria en incidentes NRBQ", Acindes, Madrid, 2012. [3] DuPont, "Classic and classic colour model CHF5: Instructions for use", [Online]. [http://www.dpp-europe.com/IMG/pdf/IFU\\_Tyvek\\_Classic-5.pdf](http://www.dpp-europe.com/IMG/pdf/IFU_Tyvek_Classic-5.pdf). [4] Indutex, "Propguard: Instructions for use", 2011

# Safety management till the 1979 near disaster at Three Mile Island

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**Keywords:** safety management; history; Three Mile Island

## Abstract

At previous WOS conferences authors presented the history of safety theories, models and metaphors; WOS2008 – human behaviour, the first safety theory, WOS 2010 – the world according to Heinrich, and WOS2012 - Occupational safety theories, models and metaphors in the three decades after World war II. This presentation will focus on developments in safety management till 1979 Objective: Which general management trends movements influenced safety management and which safety models, theories and metaphors and management solutions were introduced to explain and control causes of accidents in the period till Three Mile Island? How did this context influence the safety domain in The Netherlands? Method: The study was limited to Dutch and English articles and documents. Also the Dutch professional journal *De Veiligheid* (Safety) has been consulted from its start 1927 till 1979. Results and conclusions: Dominant management approaches started with classical management from the 19th century, with scientific management from the start of the 20th century as a main component. During the interwar period behavioural management became dominant, based on behaviourism, followed by quantitative management from WWII onwards. After the war modern management was important, a company as an open system, interacting with an environment and external stakeholders. In the 19th century no specific knowledge was developed to managing safety. Early 20th century, with its focus on cost reduction and production efficiency, safety was managed by training and selection of reckless workers, all in line with scientific management. Supported by behavioural management, this approach remained dominant for many years, even after World War II. Influenced by quantitative management, potential and actual disasters after the war, two approaches came up; loss prevention (up-scaling process industry) and reliability engineering (inherently dangerous processes in the aerospace and nuclear industries). The distinction between process safety and occupational safety became clear, and developed into relatively independent domains. In the 1970s in occupational safety human errors were seen as symptoms of mismanagement. The term 'safety management' was introduced in scientific safety literature as well as concepts as loose, and tightly coupled processes, organizational culture, incubation of a disaster and mechanisms blinding organizations for portents of disaster scenarios. Loss prevention remained technically oriented. On the other hand, reliability engineering, based on systems theory, developed the MORT technique as a management audit. The Netherlands mainly followed Anglo-Saxon developments. Late 1970s, following international safety symposia in The Hague and Delft, independent research started in The Netherlands

# The burden of work injury – why so few care

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**Keywords:** Occupational Injury; Inadequate Data; Worker; Burden of Injury

## Abstract

Injury is one of the largest sources of DALYs (Disability Adjusted Life Years) according to the Global Burden of Disease and likely to become increasingly so as improvements in public health and medical technologies are likely to reduce the effect of disease. There appears to be disproportionately few resources applied to this burden in comparison with research and intervention expenditures on medical sources of disability which have far lower rates of incidence and severity. Even within the classification of injury, the contribution of occupational injury is inadequately reflected in research and intervention efforts. This paper seeks to address possible reasons for the poor correlation between the burden of occupational injury and the resources allocated to its reduction and the underlying failure to recognize the burden borne by governments, employers and ultimately the pain and suffering of workers. The examples and issues are drawn from a developed economy, the United States, but the same issues, differing only quantitatively may be seen in developing economies such as the PRC and Viet Nam. There is a lack of academic infrastructure in the field of safety and injury prevention in comparison with disease prevention; despite the observation that US industries report injuries more than diseases by a factor of approximately one order and that, as measured by the cost of lost time and medical treatments, both categories have the same severity. Even accommodating the longer latency of disease there is widespread ignorance of the true burden of occupational injury in both developed and developing countries. The lack of resources may be seen in the lack of comprehensive occupational safety programs in institutions devoted to public health, it is safe to say there is no comprehensive occupational safety program in any premier School of Public Health in the US. Worse yet, the bulk of academic offerings in "Safety" contain offerings tangential to the problem, including for example Epidemiology of Drug Abuse, testing Tobacco Products and Alcohol Education Projects, which only serve to obscure the paucity of resources designed to mitigate a burden which approaches \$1b per week in the US. The role of the GBD in misdirection of resources is quite significant including the well-publicized criticisms of the methods used in the calculation of DALYs. Of specific concern in this paper are the distortions produced by the development of Disability Weights and the monetization of DALY's. The addition of social costs to actual costs may be valuable in the determination of disease prevention approaches where the benefits, as well as the costs, are largely borne by the general population. However such an approach is less likely to produce benefits when considered by an individual work-place owner i.e. an employer. Beyond such strategic problems there is the tactical problem of under-reporting of occupational injuries, while the popular view that this is due to the activity of unscrupulous employers has validity there are many other significant and systemic reasons for such. These technical challenges, which are addressed and illustrated by examples in the current paper, include: reporting systems, definition of work, of injury, and of occupation and very critically a lack of differentiation between job, worker and full time equivalent employee. The traditional use of jobs as a denominator in the calculation of rates is a major source of error. Were these shortcomings in the collection of accident data to be corrected then the significance of the burden borne by both developed and developing economies would become apparent and would surely lead to reallocation of resources and the reduction of work place injuries. The imperative for such reform is established by the knowledge that all the financial costs, both direct and indirect arise from the injuries and pain borne by workers and their families around the globe.

# Concept for integration of ICT solutions for safety and health towards in smart working environments

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**Keywords:** managing occupational health and safety; dynamic risk assessment; real-time monitoring; individual employee profiles

## Abstract

The Central Institute for Labour Protection – National Research Institute (CIOP-PIB) has undertaken and performed tasks aimed at developing selected technical and organisational solutions concerning the creation of an intelligent work environment. The scope of works covers research focused on the improvement of materials and construction of personal protective equipment as well as development of systems associated with their use and parameter monitoring, including in particular: electronic applications, textronic systems integrated into personal protective equipment to monitor changes in physiological parameters of the user, parameters of the work environment and protective parameters. The works above have contributed to a new project “Developing architecture of a system for the monitoring and management of occupational health and safety, according to state-of-the-art technologies and solutions applied in the area of smart work environment”, which shall include the development of a concept of a smart OHS monitoring and management system. The first step was inventory of selected electronic, textronic, mechatronic and ICT-based solutions which may be potentially applied to safety-related applications in smart working environments has been elaborated on the basis of a thorough analysis of a number of documents, i.e.: scientific articles ( 127 eferences), papers published in the conference proceedings (106 positions), information on results of research projects (29 positions), information materials published by the manufacturers (40 positions). The threshold for inclusion of a given solution into the inventory was based on a demonstrated possibility to make use of the solution to ensure the safety of workers in the intelligent working environment. The selected solutions were classified by assigning them some basic features which may be performed with regard to occupational health and safety, and specifically: 1. Monitoring of: the working environment conditions (monitoring of the environmental parameters, such as chemical substances, noise, etc.), workers’ physiological parameters (body temperature, heart rate, user’s activity, muscle performance and energy monitoring, etc.), the parameters of machinery (movement detection, location, etc.), protective parameters of personal protective equipment, 2. Warning and information support for workers (e.g. alarm signal), 3. Supporting decision-making processes, 4. Virtual reality-based training and education. Each solution was also categorised by assigning it to the certain level in the risk management process. The following levels were considered for this purpose: 1. Machines level – monitoring of parameters of machines and manufacturing processes; 2. Workers level – monitoring workers’ health conditions, hazardous factors of working environment, PPE parameters, etc.; 3. Management level – enabling managers to make decisions on the basis of an overview of current workers’ health conditions, factors of working environment, PPE parameters, machines and parameters of manufacturing processes. The selected solutions were also analysed in terms of their assignment in the hierarchy of risk preventive and protective measures. Finally we proposed concept of a smart monitoring and management system for occupational health and safety covers two main aspects, i.e. real-time reaction to changes in the work environment and customisation of risk assessment for an individual employee profile, which takes account of his/her physical and mental condition, actual conditions of the work environment and location in respect of machinery.

# A multinational and multi-sector survey among european companies with a zero accident vision

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**Keywords:** safety climate, safety culture, safety commitment, safety empowerment, safety learning

## Abstract

**Introduction:** The Zero accident vision (ZAV) paradigm is based on the idea that all (serious) accidents at work are preventable. Many companies have adapted this vision, yet there is much confusion as to whether it is a goal or a process, and little research has been carried out as to what factors are essential for a company to have a successful ZAV. As part of a multi-method, multinational European study entitled "Success factors for the implementation of the zero accident vision", we set out to develop a survey to tap into the dimensionality of ZAV. Based on previous safety culture and climate research we hypothesized (alternative hypothesis) that company managers/supervisors (leaders) would have higher scores on all ZAV dimensions, compared to workers. Our second (alternative) hypothesis was that manufacturing companies would have higher scores on all ZAV dimensions compared to construction companies.

**Method:** A 72-item survey was developed based on previous scale items and newly formulated items distributed across 11 ZAV dimensions: Organizational (n=2 items) and individual (n=5) commitment to ZAV, organizational (n=8) and individual (n=8) safety communication, management safety priority (n=9), safety justice (n=4), safety empowerment (n=6), group safety climate (n=15), safety learning (n=8), safety learning actions (n=5) and safety resilience (2). A four-point response scale was used ranging from 'Strongly disagree', 'Disagree', 'Agree' to 'Strongly agree'. For some items a 'Don't know' option was also provided, and were subsequently ignored (treated as missing) in the analyses used for this sub-study. Surveys were filled in by respondents either electronically or manually. Mean dimension scores were computed for each individual as long as at least 50 % of the items for an individual dimension were completed. The reliability of the dimensions was computed using Cronbach's Alpha, and T-tests were carried out in comparing groups. All analyses were carried out using SPSS-20.

A total of 27 companies in seven European countries were recruited (convenience sampling) by research teams in each country (Belgium, Denmark, Finland, Germany, Netherlands, Poland, United Kingdom). Manufacturing (n=13 companies) and construction (7) companies accounted for a majority of the 27 companies.

**Results:** A total of 8,526 respondents completed the questionnaire with indications as to whether they were a leader (31 %) or worker (69 %), and 52 % of respondents were from the construction industry and 29 % from manufacturing. The 11 ZAV dimensions ranged from acceptable to very good reliability (Cronbach's alpha varying from 0.70 to 0.91) for both leaders and workers, with only one problematic survey item out of the 72 items.

The 27 companies were characterised with over 90 % of both leaders and workers having scores of 3.0+ (scale 1 - 4) on the dimension 'organisational commitment to ZAV', and over 90 % of leaders and 80 % of workers having scores of 3.0+ on the dimension 'individual commitment to ZAV'.

Leaders in both construction and manufacturing had significantly higher ratings than workers on 10 of the 11 ZAV dimensions ( $p < 0.001$ ). There was less disagreement between the groups in regards to the dimension 'safety resilience'. Both leaders and workers in construction had significantly higher ratings than in manufacturing regarding 'management commitment to ZAV', whereas both leaders and workers had significantly higher ratings in manufacturing compared to construction on the dimension 'safety learning actions' ( $p < 0.001$ ).

The two dimensions with the lowest dimension scores for both leaders and workers were: 'safety resilience' and 'individual safety communication'. Preliminary interview data with the companies confirm these findings.

Discussion: In their striving to be leaders in safety (health and environment) the companies recognise the need for safety resilience and pioneering new ZAV approaches. The majority of them have very high organisational and individual commitment to their ZAV programs, yet they acknowledge that they need to greatly improve their safety resilience, as well as safety communication at the individual level. With challenging global markets companies on the leading edge of safety culture need to be prepared and to be able to recover from unexpected events.

Conclusion: Leaders/managers/supervisors had significantly higher ratings on 10 of the 11 ZAV dimensions compared to workers, and had similar and their lowest scores in respects to the 11'th dimension, safety resilience. Leaders/managers/supervisors and workers in construction and manufacturing had significantly different scores on only two similar dimensions, with higher scores in construction for 'organisational commitment to ZAV' and higher scores in manufacturing for 'safety learning actions'. The survey results will be analysed in further detail and in respects to interview data from each of the 27 companies, in the process of identifying success factors for ZAV programs.

# Virtual reality in occupational health and safety

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**Keywords:** Virtual Reality; Construction; Labour Inspection

## Abstract

Unfortunately, despite the technological developments, the number of occupational accidents and occupational diseases has been increasing day by day according to the raise of the number of employees across the world. The rehabilitation of the occupational health and safety conditions at workplaces is the key point to decrease the number of occupational accidents and diseases. Of course, there are lots of factors affecting the conditions of workplace and one of them is inspection system of these conditions. The labour inspection is an important mechanism to improve the occupational health and safety conditions at workplaces. So the education and the edification of assistant labour inspectors should be effective and adequate. With technological developments late 20th century a concept of virtual reality has emerged in the world. Firstly in game sector and then in some other sectors, "Virtual Reality" has entered into every point in our lives very fastly. As an inevitable result, it will be also used for occupational health and safety systems very soon. For this reason, Labour Inspection Board of Turkey has been started to use a new simulation system. Firstly, a mine and a construction have been modeled with a 3D program. According to the law and related legislations, all of the faults and shortcomings related with these sectors are shown in the simulation. In this study, the modeled construction will be introduced. This education system is called AROSH (Augmented Reality for Occupational Health and Safety). In this program, an excavation part of a construction has been modeled. Some of construction equipments had been imported and then the scenario was created. The entire scene rendered and a video composition created. These processes which need a huge team and lot of time, was achieved with a team of three people in a very short time with outstanding work. According to the scenario, all of the law articles about the excavation shown respectively. Thus making it easier to keep law articles in mind and gives opportunity to debate on event cases. Also a situation can be seen with lots of perspectives and can be analyzed easier. Firstly, AROSH (Augmented Reality for Occupational Health and Safety) will be used to educate the Assistant Labour Inspectors about inspections and legislations. In the second part of project, simulations will be use to raise the awareness of employers and employees. Also the program will be moved on a different platform and it will be interactive presentation with users. So a user can travel around the excavations and examine the equipments and analyze the situation as he/she lives in there. In case of an emergency or in case of a bad state he/she will confront what needs to be done. As a result, a 3D program has been used to form an education program of assistant labour inspectors. Of course this program is an open program to develop. In the future, the workplace inspections will be possible when we are sitting in our office with augmented reality and so this is the first step of this dream.

# Change laboratory: formative intervention and remodeling of the activity system of a reference center for the workers' health in the state São Paulo / Brazil

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**Keywords:** Training intervention; Change Laboratory; Organization Learning; Surveillance and Prevention; Occupational Health

## Abstract

Introduction: The Change Laboratory (CL) is a theoretical and methodological approach based on expansive learning concepts of Vygotsky and followers. It was developed in the 1990s by Prof. Engeström and his team at the University of Helsinki and has been applied in several countries, in various branches of production of goods and services. Its interventionist methodological emphasis is focused on the transformation of processes of work activities into organizations. In this approach, crises, dilemmas and conflicts in the activity are understood as manifestations of the contradictions in the system composed of subjects, the instruments used, material and immaterial means, rules, division of labor and communities. Rationale: The Workers' Health Reference Center (CEREST) is a service that acts in the prevention and health promotion of workers' formal and informal sectors of the economy. Its activities are divided into two main sectors: counseling / rehabilitation and monitoring, which are dialectically connected. The goal of the rehabilitation/counseling is to care for the pathological consequences of the activities performed by the employees, whereas the goal of the monitoring is to investigate such work processes to prevent new cases. Nevertheless, professionals of this service complain of a crisis in preventive action (dispersion performance without focusing on priorities, use of checklists that follows the regulations norms do not reach the organizational determinants). In this sense, the CL is justified to meet the challenge of prevention and was applied to improve the efficiency of the service performance, especially on the issue of surveillance with an integrated view. Those difficulties generated isolation of the professionals and loss of community at work. It was required a remodeling of the CEREST activity system. The LM in this service had the goal to engage with CEREST professionals, so that they could take ownership of the methodology and at the same time, intervene and improve the activity of the system itself, what would finally contribute for the actions in prevention of workers accident on the industries from region attended by CEREST Objective: To contribute to the remodeling of the actions of the service studied, to equate and create solutions to the structural problems faced by the service; take ownership of the formative intervention methodology; improve prevention actions performed by CEREST. Methodology: The study site was the CEREST of a municipality in the state of São Paulo / Brazil. The method used was the Change Laboratory, which allows the combination of ethnographic research with training intervention. Interventional researchers began by collecting mirror data through semi-structured interviews with Assistance and Monitoring professionals for CEREST, partners and the Coordinator of the union health



surveillance area, and by observing the work as well as carrying out document analysis. The session topics of the Change Laboratory (LM) followed the proposed sequence for Engström: 1) Identification of the current situation and needs; 2) Double blind: Analysis and search for solution; 3) New design model and new tools; 4) Application test of the new model; 5) Consolidation and reflection of the new model. At the time of writing this article, the intervention is in phase 4. The sessions began in September and there have already been 11 2-hour weekly meetings. The material was recorded, which facilitated its analysis and orientation of the conduct of training intervention sessions. The number of participants ranged from 9 to 14 people, reaching 19 in moments of decision on the change proposals in the past sessions. Results: In the early sessions, the object and the system of activities, difficulties perceived, the historical aspects of development of the work as a whole and the possible causes of the reported problems were identified. In the intermediate sessions the contradictions previously identified were discussed in depth and, in the final session, the group built a proposal for a new working model. In short, the group reflected that its object is transformed to produce a socially expected result, i.e., preserve workplaces and healthy workers. The contradictions raised by participants are related to the growth of demand and low number of staff, therefore, since its implementation in 1997, there have been advances in the quality of employment arising from search and appropriation of new tools for in-depth analysis of occupational accidents and care for the victims. It became evident the conflict between meeting the high number of demands and the failure to carry out a more skilled labor, using the broader approach of tools, most of the requests received, which creates significant contradictions between the subject and their object. It was also pointed out the decrease of exchange of information between sectors over the years, making it difficult to integrate activities. The new model proposed provides for an information room, which will update the data for the work-related accident victims and patients, as well as feed the planned actions of the service. A new division of labor is on trial, established to balance the demand, with the replacement of individual supervision by a multidisciplinary team, through a daily duty system in order to analyze the emergency demands, meet the priorities or refer them to the schedule of planned actions. At the sitting scheduled for next April, the results of the operation of the service will be discussed in the pilot format for validation and future remodeling of the activity system. Conclusion: The discussion about the origin of the contradictions and conflicts by Change Laboratory method allowed the participants to understand that the problems are systemic in nature, alleviating conflicts previously explained as the result of individual behavior. The engagement of participants resulted in the learning of the methodology, the beginning of more decentralized and democratic decision-making processes as essential attributes to implement the desired changes which were the re-design of the actions in prevention of workers accident performed by CEREST. We thank all CEREST team for the availability to participate in the interventions and the writing of this article. The study is part of the thematic research project "Work Accident: The technical partner analysis to the social construction of change," Prot. FAPESP 2012 / 04721-1.

# How safety authorities consider human and social aspects in the inspections of the industrial handling of hazardous chemicals and gases? – a Finnish safety authority case

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**Keywords:** sociotechnological; regulation; case study; safety; inspection

## Abstract

Safety of industrial activities has traditionally been regulated on the basis of technical norms and technical inspections. However, thorough investigations of major accidents as well as occupational accidents have shown that human and social aspects are very essential to safety. Some social aspects have recently been included also in regulation as an implication of findings of accident investigation. Social aspects have typically been approached in norms and standards by means of formal safety management systems. In this case study it has been examined how well current regulation practices (based on the technical tradition and normative management system approach) catch the sociotechnical reality of safety management in enterprises. The study has focused on the supervision of the (safe) industrial handling of chemicals and gases carried out by the Finnish Safety and Chemicals Agency (Tukes). The principles and practices of regulation have been examined on the basis of relevant documents as well as the interviews of the group responsible for the national supervision. Leaders and 10 out of 16 inspectors were interviewed. The preliminary analysis indicates that the inspectors do pay attention to the social aspects of the organisations: e.g. attitudes of the management and the personnel, and the visible indicators of the safety culture. It is also formally a part of their inspection plan. Inspectors have, for example, notified certain differences on the attitudes to safety between different industries: The general observation is that, the bigger companies in general and the companies producing and handling chemicals as their core business have better attitude and practices in considering safety issues than companies in other businesses (even though they were handling significant amounts of hazardous chemicals). There are, though, many limitations to inspectors' chances to assess the social aspects of the organisation and their implications for safety. For example, the time allocated for supervision of each organisation is very limited. The educational background of the inspectors is technical or chemistry. There are no specific tools for assessment of the social aspects. The inspectors described that they have developed certain skill to recognize the social aspects. This skill is based on experience and mutual learning. However, they are somewhat uncertain to explicitly report and remark on their observations on the sociotechnical aspects. An interesting question is also what are inspectors' and the Agency's responsibility and accountability related to the social and technical safety performance. Basically the enterprise is always finally responsible and accountable for its safety. Inspectors are responsible to carry out the supervising tasks that are specifically determined to them by the law. However, the actual supervisory work requires a practical application and interpretation of the law text. The consistency of the interpretations is upheld by preparing guidelines and mutual learning. Inspectors see their role primarily as advisors or coaches to the enterprises rather than executors of command-and-control approach. Sanctions are available but they are rarely used. The key guiding principle is to ensure enterprises equal opportunities to operate while safety is sufficiently assured. It seems that in regulation there is an intention and efforts to take into account a sociotechnical aspect of safety. However, the prerequisites and conventions to accomplish this are not yet very well developed. Still somewhat open question is: to what extent the social aspects of safety can and should be affected by the means of regulation, and what would be appropriate tools and procedures for that. This case study is a part of the STARS project including two other similar cases in France and Norway and theoretical study on sociotechnological approach on safety. The study is based on the common study protocol determined in the project but this presentation forms only an example on how the sociotechnological aspect in the work of authority may be examined. The final results of comparing all three cases and conclusions on the sociotechnological approach on safety regulation will be otherwise published.

# An holistic approach to describe and prevent work related collisions between different companies and industries: a Quebec initiative

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**Keywords:** work related collision; prevention; workplace program; collaboration

## Abstract

Background: In Quebec (Canada), a report from the Commission de la santé et de la sécurité du travail (CSST) showed that approximately 2% of all workers who receive compensation were involved in a work-related road collision (WRC). Yet, road collisions account for 25% to 30% of all work-related accidental deaths and are the leading cause of work-related accidental deaths. Despite this, relatively few studies have examined the characteristics of and the risk factors associated with this type of event. For the most part, this is due to a lack of integrated databases containing information about both compensated workers and the circumstances of the accidents, such as causes, road configuration, time and day of the accident, type of vehicle involved, and weather conditions. Therefore, there is a strong argument for Occupational Safety and Health department inside different agencies to undertake more data collection, leadership and enforcement of occupational road safety, which seems to be one of the major at-work risks in many jurisdictions. Even though information exists to monitor work-related road collisions such as police reports or occupational safety and health reports, little has been done to develop a clear understanding of the burden of these collisions in the industry. Since these types of information are often gathered individually and differently based by companies, it is hard to draw connections between them. Moreover, rarely we can see a common effort to gather all this information in a standardized way in order to conduct comparisons across industries. Aim: The aim of this work was to get representatives of different companies and government services to put forward a joint effort to tackle the issue of road safety among their employees by merging their practice in terms of reporting work-related road collisions. Methods: For this approach, the targeted groups were representatives from various sectors working as human resources and health and safety specialist who aimed at reducing the burden of work related collision of their employees. A total of twelve companies participated in this collaboration process. Sectors included representatives from Energy Sectors (2), Telecommunications (3), Municipalities (2), Public transportations (2), first responders (1) and Food and drinks retailers (2). Representatives met during several occasions to agree on a merged format to report work-related work collision. Currently, only limited data linkages exist, for example, between road safety statistics, health and safety or insurance data. Better linkages via common coding and interagency collaboration would enable a more complete picture to be obtained. Results: By conducting a series of meetings and discussions, representatives from various sectors were able to come to a consensus on a reporting tool for work related collisions that will enable broader interventions since it will standardize procedures to report occupational accidents. Pilot extractions are now being conducted to evaluate if every participating agencies is able to collect the information they are interested in a merged report. Discussion and Conclusion: The wide variety of jobs and diversity of industries concerned by WRC goes far beyond the trucking industry as one might expect. This will not only benefit safety among one industry but across all participants in this integrated road safety initiative. Such results will contribute to a better understanding of the problem and enable better interventions in the workplace.

# Airline operation. Local thermal discomfort in the cockpit of commercial aircraft on medium-haul flights

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**Keywords:** Thermal Comfort; Airline Operation; Cockpit

## Abstract

Revised Version: To prevent accidents and occupational diseases the Measuring Technical Service of the BG Verkehr, the German accident insurance for the transport and logistic business, investigates the chemical exposure and thermal comfort at different work places of their member companies. In the last years the main focus was on chemical exposure and thermal comfort at mobile work places such as cockpit and cabin of commercial aircrafts. Optimal room climatic conditions are closely related to health and satisfaction of employees. Deviations to exposure to cold or heat in the workplace lead to a reduction of performance, job dissatisfaction and are possibly endangering the safety and health. Therefore deviations in optimal room climatic conditions i.e. in airline operation became part of the obligatory risk assessment of the workplace. One of the objectives of this investigation was to evaluate the thermal local discomfort in the area of the pilot seat especially focusing on: 1. Cold feet and warm head at the same time, caused by large vertical air temperature differences. 2. Cold feet, caused by uncomfortable floor temperature. In this context pilots mentioned that after only 2 or 3 hrs flight duration on an Airbus A 320 without foot warmer even with thick socks and lined shoes, both pilots' feet started to get numb. To avoid possible risks of occupational safety and flight safety the thermal situation was investigated on 8 flights from Germany to Egypt and the Canary Islands (3 flights with foot warmer, 5 flights without foot warmer). The course of the floor temperature near the pedals in the cockpit over the entire flight (4-5 hrs) as well as the vertical temperature profile at the pilot's seat at three measuring points was measured. In addition the inflight floor temperature in the galley was measured on the last flight. Results: The highest measured temperature gradient between head and feet area at the pilot's seat was 19 K (without foot warmer). The lowest measured floor temperature was 276,65 K (+3,5°C, 38,3°F) (without foot warmer). In the aircraft cockpit with foot warmer significant deviations from thermal comfort standards could not be determined. The measured floor temperature was significantly low (< 0°C) near the flight attendant seat. This caused also a large vertical air temperature differences in the galley. On the 12th of March 2015 functional tests of the retrofitted foot warmer on a flight from Germany to the Canary Islands were carried out. Initial evaluations indicate significant improvement in thermal comfort in the cockpit. It is further planned to conduct a flight with a measurement dummy inside an aircraft in summer 2015 to broaden the data base about thermal stress inside the cockpit. These results will also be presented. Discussion: Taking into account ISO 7730 "Ergonomics of the thermal environment - Analytical determination and interpretation of thermal comfort using calculation of the PMV (Predicted Mean Vote) and PPD (Predicted Percentage of Dissatisfied) indices and local thermal comfort criteria" there is thermal local discomfort in aircraft cockpit without foot warmer on medium-haul flights. Measures / Recommendations: By use of auxiliary electrical heating systems (foot warmer) an increase of working performance of the cockpit crew is possible. An increase of flight safety is to be expected and thereby a possible peril of passengers can be prevented. A possible measure to avoid thermal discomfort in the galley is a so called curtain which can be used to cover the cabin door on medium and long haul-flights.

# Rhetorical accounts of risk: interprofessional interaction in informal risk assessment

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**Keywords:** risk discourses; rhetorical discourse analysis; risk assessment

## Abstract

In the context of high-risk industries, risk assessments take place not only through standardized methods and structured risk analysis meetings such as HAZOP or HAZID. Risk is frequently assessed and negotiated in other meeting settings in which operational adjustments and changes are managed. The current study explores how risk is formulated and accounted for in a setting where risk analysis is not the primary objective, but where various forms of risk assessment occur as an integral part of operational decision making. The site in question is a weekly interprofessional planning meeting in the petroleum industry in which decisions regarding the re-scheduling and re-prioritization of maintenance activities on offshore oil and gas wells are made in response to the continuous fluctuations in operations. As the operational situation changes, the operational plans must be adjusted and tasks re-scheduled in order to optimize resource allocation, sustain production, and ensure the safety of personnel onboard. However, the meaning and consequences of operational changes and their implications for safety have to be established and negotiated discursively through interprofessional meeting talk. A series of meetings in operational planning were video recorded, transcribed, and analyzed using a rhetorical discourse analytic framework. This approach allows for a detailed look into the accounts of risk presented by the professionals and the rhetorical devices they employ in order to reach communicative goals. Accounts are, in this context, descriptions of risk given by participants, and these descriptions are seen as interactionally designed with reference to how they will be recognized and understood by others, and as constructing preferred meanings for problematic events. One decision-making trajectory is presented in detail in order to show how accounts of risk are presented and negotiated in this particular setting, and how an episode of disagreement reveals the tensions that exist between the different domains of expertise and responsibility represented in the meeting. The analysis shows how the accounts of risk are increasingly persuasive and rhetorical as the disagreement over risk and prioritization become evident. The episode is characterized by the shifting rhetorical strategies of 'categorization' and 'particularization'. These rhetorical strategies can be seen to echo established risk discourses, often referred to as 'probabilistic' and 'contextualized' conceptions of risk. Competing conceptions of risk are used interchangeably and strategically by the participants as they account for risk or absence of risk. The different risk discourses can in this way be seen as rhetorical resources for the participants in their negotiations over the meaning of risk and in their attempts to construct persuasive arguments. The accounts of risk, then, are not seen as simply objective tools for weighing probability and consequence, but rather as powerful tools for achieving specific professional outcomes. The accounts of risk in this episode are also found to be highly mediated by the organizational role-responsibilities and interests of the participants. This calls into question the achievement of balanced interprofessional risk assessments if disagreements over the meaning of risk grow out of a battle over resources or performance targets in the different departments. Interprofessional risk assessment, as it occurs in both formal and informal meeting settings, is a dynamic process involving persuasive elements and rhetorical strategies that go beyond traditional conceptions of risk or established methods for risk analysis. Acknowledging the discursive and rhetorical elements of risk assessment might encourage awareness among professionals of the interactional dynamics that are at play when professionals negotiate the meaning and consequence of risk. The study contributes to the understanding of risk assessment at its most concrete and practical level, as it takes place through professional interaction and the creation of persuasive accounts.

# Trends in managing occupational proactive safety activities in enterprises during a period of economic recession

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**Keywords:** Psychosocial working environment; Occupational accidents; Survey; Workplace assesment; Economic recession

## Abstract

Not much research has focused on working environment factors and national economy. This has for example been documented by a systematic analysis of the content of two influential journals within the area occupational health psychology where it was found that only a very limited number of the research papers published in the journal paid attention to the impact of economic factors on occupational factors at the work place [1]. None the less, in a UK work force survey initiated during times of economic recession it was found that a significant part of the workers share the opinion that the economic conditions have an influence on working environment factors like for example relationship to colleges or working longer and harder [2]. Moreover, in the Stormont study it was found that a several psychosocial factors are negatively correlated with the onset of economic recession [3]. One of the conclusions brought forth in the study is that there is a need for more focus on the management of proactive safety activities in enterprises during a period of economic recession. From a theoretical point of view models explain that a number of working environment psychosocial factors is negatively related to economic stress in two ways. First, workers may be affected directly, for example, dependent on their ability to cope with economic stress. Second, workers may be affected indirectly by for example enterprise organisational changes with respect to managing occupational pro-active safety activities. An interesting research question is whether the onset of a general economic recession has had an impact on companies' proactive occupational activities? In particular we will discuss trends from the five year period that might reveal change in practises in the administration of the so-called work place assessments in Danish companies and public organisations. Likewise we will discuss trends on preventive actions, attitudes and knowledge related to the management of occupational risks within the area of psychosocial work environment and occupational accidents. In 2005 the Danish government launched an action programme that focus on occupational health and safety activities. The goal of the plan was during a five year period to put focus on four so-called "problem" areas: psychosocial work environment, occupational accidents, noise at the workplace and muscle-skeletal distress. I addition, it was decided to follow the development of Danish enterprises' occupational safety activities through the five year period based on a questionnaire based study. A baseline for the study was established in 2006. The 2006 sample consists of 9720 companies and public institutions. In 2011 the questionnaire was applied again. The 2011 sample consists of 6724 companies and public institutions. Both samples are stratified according to employee size and industrial sector. The questionnaire studies are cross sectional and the participating enterprises are randomly selected from the Danish register of companies that have to pay taxes or otherwise by law are obliged to register. The response rate in 2006 and 2011 respectively was 76% and 44%. The difference in response rate is most likely due to the general economic recession during the data collection period – some companies might not be so willing to reply on questionnaires if they are struggling to survive. Moreover, it might be due to differences in data collection techniques. The results indicate that the enterprises in 2011 have had more focus on managing psychosocial risk factors that they did in 2006. In addition, in 2001 more companies and public organisations have worked out psychosocial work environment actions plans as part of their work place assessment activities. With respect to the management of proactive activities within the area of occupational accidents the picture is a bit different. As such in 2011 fewer companies and public organisations have prepared occupational accident actions plans as part of their work assessment. In addition, it is found that fewer companies than in 2006 have initiated safety rounds on a regular basis. With respect to prevent machine accidents there has been an increase in proactive activities only in a few single areas, while there has been a

decrease in several categories of proactive activities with respect to prevent falls. References 1. Kang, S. Y., Staniford, A., Dollard, M.F., Kompier, M. (2008). Knowledge Development and Content in Occupational Health Psychology: A Systematic Analysis of the Journal of Occupational Health Psychology, and Work & Stress, 1996-2006, pp 27-63. In J. Houdmont & S. Leka & (Eds), Occupational Health Psychology: European Perspectives on Research, Education and Practice (Vol. 3), Maia, Portugal: ISMAI Publishers. 2. Mind / Populus Workplace Health and Stress Survey, March 2010 [http://www.populus.co.uk/wp-content/uploads/download\\_pdf-210310-Mind-Workplace-Health-and-Stress-Survey-March-2010.pdf](http://www.populus.co.uk/wp-content/uploads/download_pdf-210310-Mind-Workplace-Health-and-Stress-Survey-March-2010.pdf) (accessed 10 January 2015). 3. Houdmont, J., Kerr, R. and Addley, K., 2012. Psychosocial factors and economic recession: the Stormont Study Occupational Medicine. 62(2), 98-104

# How to support managers' commitment to safety management and leadership in organizations: good practices from the managers' viewpoint

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**Keywords:** Commitment; Management; Engagement; Safety; Leadership

## Abstract

The managers' active role in safety is one of the key elements for successful safety management. Managers have the capacity and power to make safety-related decisions. Moreover, through their actions and examples, managers can positively affect safety culture and climate and thus support employees' behaviours and activities in matters of safety. The role of safety leadership now receives great emphasis in the development and promotion of safety culture and climate. Research has increasingly supported the view that leadership style affects employees' safety behaviour and levels of safety performance in an essential way. Safety commitment can be defined as the extent to which managers place a high priority on safety and how they communicate and act effectively on safety issues. This definition has a close connection to the concept of safety leadership. Despite managers' essential role, some show low levels of commitment to safety and prioritize production criteria. Thus, the level of implementation of safety management procedures may be quite low, allocation of resources for preventive actions could be limited, and managers may only seek avoidance of legal responsibilities when adhering to formal compliance with regulations. Based on previous literature, to improve safety, support of the managerial role in safety as well as the safety leadership is required. Information is needed on the factors that help and hinder managers' commitment to safety to implement organizational measures that support managers in safety activities. Previous research related to managers' safety commitment has focused on different managerial actions that demonstrate commitment from employees' viewpoint. Research approaching commitment from the managers' own viewpoint is scarce. This paper discusses factors that influence managers' commitment to safety management and leadership as well as organizational measures that could support their commitment. The objective of this paper is to chart factors that influence (help and hinder) managers' safety commitment and review related measures and best practices based on literature and empirical findings. The focus is on the managers' viewpoint and organizational factors and measures. The study consists of a literature review of managers' safety commitment as well as engagement in the non-safety domain and managers' thematic interviews (n = 51) in five Finnish industrial organisations (energy and processing industries and industrial services). The study is part of the research project: "Safety leaders: Safety leadership, competence and commitment of managers". The project is conducted at Tampere University of Technology between 2014 and 2015. According to the literature, research in the non-safety domain has shown that, in addition to individual factors, contextual factors existing in the work environment importantly affect leadership engagement, although they are less frequently studied. Physical, social and organisational demands (e.g., hazardous work environment) and resources (e.g., peer support) may affect engagement positively or negatively, depending on context. Managers' commitment to the safety role arises from increased safety awareness, which may be induced, for example, by an accident or other crisis, or by a training or safety improvement programme. Commitment can be promoted, for example, by workshops and training that consist of joint discussions, which construct a shared understanding of safety issues. Training and guidance programmes, especially those designed for senior managers, should focus on their problem-solving abilities and perception of others in order to support them in demonstrating a commitment to safety. Based on the preliminary results, contextual factors, such as role overload, production demands, formal procedures, workforce attitudes and managers' attitudes, hinder managers' commitment to safety. The factors that help managers' commitment to safety are, for example, understanding their own responsibilities, the moral obligation to maintain employee safety and the bearing of safety on



the business, clear safety objectives and emphasis, acknowledging and rewarding positive activities, uniform organizational procedures and their implementation, top management commitment and support and safety improvement itself. Measures that support managers in their safety activities include organizational support in safety activities, inspirational and participative management training, appropriate safety objectives, peer and superior support, campaigns and competitions, employee safety training and simplified safety procedures and reporting. Based on the results, effective measures to support managers' commitment to organizational safety objectives and programmes are suggested, and they may be utilized in a variety of organizations to promote safety.

# Safety management issues in the transition from project development to project construction in the construction industry

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**Keywords:** project work; safety management; construction industry

## Abstract

Many of the accidents and safety challenges in the construction industry could have been prevented by improved systematic safety management and safety awareness in the project development phase and in the transition between the development and construction phase. The purpose of the paper is to identify issues one should be aware of in the transition from project development to the project construction phase. A simple phase model for project work includes four main phases. The first is business development, which includes investigations of business opportunities and pre-feasibility studies. The second phase is the project development phase where plans and drawings are made. The third phase is project construction where the construction work is done. This is also the phase where workers are killed and injured. The fourth phase is operations, i.e. usage of the constructed building or infrastructure. Studies in different countries have demonstrated that 40-60% of the fatal accidents could have been prevented by better decisions and actions in the project development phase. Designers' (architects and engineers) lack of safety knowledge and their unawareness of regulations are obstacles for safety improvements in this industry. Decisions and actions made upstream from the construction site influence safety at the construction site, e.g. the design of a project; drawings; and plans. A closely related challenge is the transition from the project development phase to the project construction phase. This paper pays attention to this transition. The paper is based on 24 interviews with representatives from clients and construction companies at two different projects. Both projects were large projects where transportation infrastructure was constructed. Project managers, site managers, operation managers, HSE coordinators and safety representatives were among the interviewed employees. The interviews lasted for about 1 hour each. The interviews demonstrate the importance of the transition between project development and project construction. This is a transition where quick initialization of project construction is prioritized ahead of a smooth start-up with communication between designers and construction companies and other involved actors. The interviewees made strong arguments for an increased focus on this transition. Analysis of the 24 interviews identifies important issues for this transition phase. This is related to which actors to involve in the transition and what safety-critical information should be communicated between these actors. Other contents include agreements on how to collaborate and communicate during the construction phase; how to ensure continuity of key personnel; how to ensure safety of workers with regard to preventive measures, safety requirements; risk awareness and housekeeping; how to ensure quality of drawings, plans and work; and how to ensure open and fair communication during construction. In addition, practical issues related to length of the transition and number of meetings is discussed. The list of defined factors can be used as a checklist on what different actors should be aware of when going from project development (planning, engineering) to construction. Based on our discussions of the transition between the two phases we suggest that a new phase is introduced in a project phase model, the collaboration phase.

# Decision support for operational decisions affecting major accident risk

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**Keywords:** Operational risk; Decisions; Risk assessment

## Abstract

In risk analysis, risk is traditionally expressed as probability times consequence of unwanted events, in effect a statistically expected loss, usually measured per year. For decisions with long-term effects, this is a useful way of measuring risk because we can compare options and select those that over a long period of time will minimize our losses. Typically, when designing a new process plant, a risk analysis will provide useful input. In the offshore industry, the quantitative risk assessments that are performed to support the design process is a good example. In the operation of a plant, there will be numerous decisions every day that have primarily short term effects (e.g. introducing increased risk while performing some work). These may be called operational decisions. If we are faced with a decision about whether it is safe to perform a specific job that is being planned, the long-term average consequences of this are of limited relevance. Ideally, we would like to know whether an accident will occur or not, and we would then of course stop the operation if we knew that an accident would take place. In reality, this is of course not possible, but it is still an indication that there may be a need for different types of information about risk in operational settings compared to when making long-term decisions. "Modelling instantaneous risk for major accident prevention" (MIRMAP) is a research project financed by the Norwegian Research Council, Statoil and Gassco. Its main goals are to explore what information about risk is useful for making operational decisions in a process plant. The starting point has been to look at the types of decisions that are commonly taken at an operational process plant. The objective has been to gain a better understanding of the types of decisions, how they are made and what input is used to make the decisions. An important finding from this is that the number of decisions influencing major accident risk is very high, of the order several hundred per day. Providing improved decision support is therefore not just about developing more detailed or advanced methods for analysing risk, but also about finding simple ways of screening the situations, to improve the chances of picking up critical work operations at the same time as avoiding that the work load increases too much. The main bulk of the project is therefore about developing methods for screening the work operations, to select those that require a detailed consideration by staff at the plant. In effect, we may link this to Kahnemans "fast" and "slow thinking". All jobs with low risk potential can be handled by "fast thinking", being efficient and not consuming too much time and resources. However, for jobs with potentially high risk associated with them, we want to move the staff into "slow thinking" mode. This requires more information than just a quantitative risk measure and a simple acceptance criterion. Instead, the intention with this information is to trigger reflection, both to gain better understanding of the risk and to improve the possibilities for identifying good risk reducing measures. The method is still under development, but the main ideas and the conceptual model will be presented. Details will be developed in the coming year, and this will also include testing of the model on actual cases from a process plant.

# Does bridge resource management work? Assessment of a training course.

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**Keywords:** Bridge Resource Management; BRM; Training; Simulation

## Abstract

Bridge and engine room resource management (BRM/ERM) courses are mandatory to get certificates according to STCW 2010 (The Convention of Standards of Training, Certification and Watchkeeping - International Maritime Organization IMO). The BRM/ERM courses are designed to enable all maritime personnel on/off shore to develop their existing knowledge and understanding of human and technical resources in an operational maritime environment. During the course the crew gain experience in handling ships under various conditions, improve communication quality, improve quality of decisions and in a more effective way contribute to the bridge team during ship maneuvering in normal and emergency conditions. Recent advances in technology have positioned simulators as powerful tools for creating more realistic, experiential learning environments and thereby helping organizations meet the BRM training challenges. A training simulator is a tool for creating a more realistic learning environment, providing the trainer with a virtual medium through which various types of knowledge, skills and attitudes can be acquired. Antani (2002) define training as "the systematic development of employees' knowledge, skills and attitudes that are required for an organization to meet its goals." Knowledge refers to factual information and skills refer to the learned capacity to perform some type of task. Unlike knowledge, skills typically include a physical component that must be developed through practice and feedback. Maritime Operations AS is offering four different training options leading to BRM certification, dependent on the seafarer's previous education. All four courses teach theory and link it to practice through simulator training. A questionnaire with 46 items was distributed to 317 seafarers who attended the courses between April 2013 and March 2014 resulting in a total of 112 completed questionnaires. In the sample the median age is 40 (from 21 to 66 years); almost 70 % worked on offshore vessels, 85 % were officers, 62, 5 % attended the course together with other members from the same crew. Almost 53 % of the respondents reported that they had experienced highly stressful situations that the BRM course helped them tackle. Between 88 and 97 % of the respondents evaluated the theory part of the course including themes like communication, decision-making, situational awareness, cultural differences and the human elements as useful and important. Most of the respondents (77.7 %) reported at they had improved their communications skills as a result of the course, 64.3 % reported that their decision-making skills had improved. Debriefing was evaluated as an especially important part of the course since around 96 % of the respondents reported that debriefing after each training session was useful or very useful. Results indicate that 85.6 % of the variation of "Change in behavior as a result of the BRM course" was explained by the combination of increased skills, change in attitudes, and increased knowledge and understanding, however, increased skills influenced the behavior 3 times more than change in attitudes and increased knowledge and understanding. Both the course content and the pedagogical approach was important for increasing skills, changing attitude and knowledge, but the pedagogical approach with use of simulators were perceived as twice as influential as content of the course. One can conclude that using simulations in BRM courses have great potential as a medium to create highly-relevant training contexts where the bridge teams are active participants in a learning process that create specialized and adaptive knowledge and skills. References Antai, A.S. (2002). Management of human resources. Calabar: Pyramids Publisher

# Safety culture – the hard rock that turns back our spade?

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**Keywords:** safety culture; culture of prevention; education and training; mainstreaming OSH into everyday life; mainstreaming OSH into education

## Abstract

Workplace safety leaves the shelter of traditional engineering and economic sciences when the concept of culture comes into play. Using terms such as safety culture or culture of prevention challenges us to deal with something that cannot be put into rules without it becoming meaningless or senseless at the same time. The objective of permanently, and thus sustainably, incorporating safety and health into companies, government bodies and educational institutions requires placing value on everyday practice, on the “this is simply what [we] do”. It also requires taking a closer look at the “hard rock” of practice which “turns back” the “spade” of prevention (Ludwig Wittgenstein, PI #217). This paper will attempt to do this in two ways. In the first attempt, the “topsoil” (humus) of prevention will be dug up and the current status of the debate on safety culture and culture of prevention will be reviewed. In the second attempt, current examples will be shown of how safety and health could be sustainably inserted into the bedrock of practice.

1. The humus of prevention: The state of the current discussion  
Safety culture is the springboard for the development of a culture of prevention. Without safety (Vision Zero) there is no culture of prevention. However, a culture of prevention goes beyond just the concept of a safety culture which traditionally focuses on workplace risks and high-risk sectors. In contrast, a culture of prevention encompasses not only work-related safety and health factors but also other factors which go beyond the workplace. At the centre of a culture of prevention is the active human being who links their actions with a subjective sense of meaning. However, this subjective sense always has a social basis. To discuss the development of a culture of prevention, it is important to look at the difference between actions and behaviour, to take into consideration implicit knowledge versus explicit knowledge, and to be mindful of the importance of the pre-reflective level of human action. These aspects will be looked at in more detail in this paper.

2. The bedrock of practice: Approaches to effectively integrating safety and health  
If everyday life is more than just meaningless routines, then what can education and training contribute to the development of a culture of prevention in companies, government bodies and educational institutions? How do we get to the pre-reflective level of human action which lies beneath observable behaviour? How do we make it possible to truly experience respect for human life, for the dignity of others and a feeling of one's own dignity? How can we adjust our everyday working and learning life to have a sense of well-being? How can we start a process whereby people believe that integrating safety and health into their everyday activities is important and meaningful? In order to answer these questions, several practical examples from different sectors will be provided: 1) the holistic, pedagogical “Whole School Approach” in which students, teachers, parents, service staff and the community are continuously involved in the development of a good, healthy school; 2) a cultural-economic approach to the development of social practice, that is, the morals that are actually lived out by managers and supervisors in a company; and 3) a neuroscientific-constructivist approach to training labour inspectors how to implement the psychosocial work programme of the Joint German OSH Strategy. [This paper could also appear under the topic: Education, training and lifelong learning]

# Integration of ergonomics in the implementation of continuous improvement

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**Keywords:** Ergonomics; Lean Manufacturing; Six Sigma; DMAIC cycle; Working conditions

## Abstract

Abstract From a working conditions point of view the successful implementation of continuous improvement management practices in production systems requires also the adoption of human centred approach which considers the worker needs and limitations, as well as workplace safety. Lean Manufacturing and Six Sigma are the two major approaches to implement continuous improvement, since they are focused on increasing performance by reducing production waste, variability and costs (Dul & Neumann, 2009). However, such interventions can take a toll on working conditions since their goal is to maximize production minimizing resources, which can affect workers (due to higher physiological and psychological loads) (Pepper et al., 2003). In fact, according to these authors a decrease of the working conditions often results from the implementation of Lean Six Sigma in companies. Considering this fact, Ergonomics can play a key role during the implementation of these paradigms, to preserve health, well-being and safety of workers, namely by addressing the prevention of occupational accidents and trauma. Lean Manufacturing was developed by Toyota after World War II. It is focused on identifying and removing waste in order to attain a better quality, lower production costs, and a shorter lead time (Wilson, 2010). The eight different categories of waste considered (overproduction, waiting, motion, inventory, transportation, defects, under-utilized people/talent, overprocessing) are related with the non-added value activities. Six Sigma was developed in the 80s, by Motorola, in order to improve the quality and reduce the defects of its products (Arnheiter e Maleyeff, 2005; Montgomery e Woodall, 2008) in response to an increase of the international market competitiveness created by Japanese companies. The Six Sigma philosophy is based on a set of tools and methodologies and seeks to improve processes' output quality by detecting and removing defects causes. Ergonomics is a science that studies the interaction between human and the work environment. It is based on a systems approach oriented to optimize production systems by reducing the incompatibility between human and productive process. This paper analysis the impacts of implementing Lean Six Sigma, and addresses the strategies required from an Ergonomic perspective to avoid the compromise of the working conditions when higher productivity is expected with fewer resources. For this it is presented and discussed a conceptual framework for the integration of Ergonomics and Lean Six Sigma in implementation of continuous improvement processes. The framework proposed is based on the DMAIC cycle, which is the core tool used to implement Six Sigma projects. DMAIC is the abbreviation of the five steps (Define, Measure, Analyze, Improve and Control) walked through in the continuous improvement process. All of these process steps are required to be performed in the given order. The proposed approach is that tools and methodologies from the Ergonomics domain are added to the DMAIC cycle so that the continuous improvement process also encompasses safety and working conditions, therefore contributing to occupational accident and trauma prevention. References Arnheiter, E. D., Maleyeff, J. (2005) "The integration of lean management and Six Sigma", The TQM Magazine, Vol. 17, 5-18 Dul, J., Neumann W.P. (2009) Ergonomics contributions to company strategies. Appl Erg. 40(4):745-752 Montgomery, D. C., Woodall, W. H. (2008) "An Overview of Six Sigma", International Statistical Review, Vol. 76, 329-346 Pepper, L., Messinger M., Weinberg J., Campbell R. (2003) Downsizing and health at the United States Department of Energy. American Journal of Industrial Medicine. 44(5): 481-491 Wilson, L. (2010) "How to Implement Lean Manufacturing", I. McGraw-Hill Companies

## Management of chemicals in micro-firms in Cyprus – results from a nationwide survey

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**Keywords:** Cyprus, employers, health and safety, micro-firms, survey

### Abstract

Management and safe storage of chemicals in micro-firms (<10 employees) is a critical issue due to their lack of resources and the limited – in certain cases – knowledge on the subject. Micro firms are prone to accidents due to the lack of expertise and absence of a concrete safety management structure. The impact an accident can have on a micro firm can be substantial. Management of chemicals - in this context - can create additional risks in the workplace. It is also an under-researched area in the international safety literature. While there is limited, yet comprehensive literature and survey results focusing on Small and Medium Enterprises (SMEs), there is very little evidence on micro firms. Micro firms tend to portray casual attitudes when it comes to safe storage and management of chemicals and as a result the role of a safety management system (including aspects of safety culture) is crucial in accident prevention.

This paper is based on a nationwide survey with the cooperation of the relevant health and safety authority among micro-firms in several economic sectors. Micro-firms comprise a major percentage of business firms in a small economy like Cyprus. The survey involved the workers and the owners/managers of the firms, but also obtained information for compliance and safety performance of the particular firms from safety inspectors. The proposed approach overcomes potential problems of common method bias when all data are obtained from the same group of respondents.

Safe storage and management of chemicals is a sensitive issue with potentially catastrophic consequences in human, company as well as societal level. Micro firms employing a small number of employees tend to portray certain types of safety behavior that resemble the degree of relationships between the workers and management. Employees and employers – due to the small size of the firm – tend to develop a “sense of belonging” with the firm and sometimes undermine safety rules. In addition to that, it is reported, in literature that the role of the manager in a micro firm is decisive. The financial crisis has added to that by adding extra costs, less employees, more stress in the workplace and an increased possibility of accident or mismanagement of chemicals.

The paper – a part of a wider nationwide survey to collect information on the management and storage of chemicals in micro SME firms – deals in a holistic way with information related to employees, employers and their role, strategies and attitudes towards safe storage and management of chemicals in the workplace. In addition to that the survey examines – partly – various ergonomic factors relevant to the topic. It is work-in-progress and at a later stage, further to appropriate analysis, will yield information regarding employees as well as employers in micro firms.

The paper presents only the results related to the perceptions of owners/managers and safety inspectors. Information was collected on demographic characteristics of firms and major influencing factors of safety performance such as employee participation in safety decisions, worker willingness to use personal protection measures, and safety training. The analysis of

data has produced some interesting results showing the relationship between safety policy and good practices on the one hand and safety performance on the other, even in micro-firms. The safety performance measure, an index comprising several safety performance aspects assessed by the health and safety inspectors, has a positive and statistically significant correlation with the existence of safety policy in a firm, as stated by the owners/managers of firms. Results present the current situation with regards to the safe management and storage of chemicals.



## Web-based solutions to support communication and learning in a network: case Finnish zero accident forum

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**Keywords:** zero accidents; network; communication; ICT; learning

### Abstract

Accidents have a negative impact not only on health, but also on the success of a company, its image, recruitment practice, and staff turnover. It is therefore important to develop new methods and approaches for improving safety. For this, the zero accident vision is increasingly adopted by companies. The vision is based on the belief that all accidents are preventable. In Finland a Zero Accident Forum was founded in 2003 to support workplaces in promoting safety and health. The Forum is a voluntary network and it is open to any workplace, regardless of its size, economic sector or level of occupational safety. Commitment to the zero accident goal is the key to Forum membership. In joining the Zero Accident Forum, workplaces commit to working together to improve safety. A total of 326 organizations belonged to the Zero Accident Forum in March 2015. These workplaces employ over 335,000 people, which is more than 10% of the Finnish working population. The members of the Forum share the common vision of becoming leaders in safety, and are willing to share their experiences for the benefit of other members. The Forum provides examples of good practices from other workplaces, spreads success stories, creates opportunities for networking and learning from others, and motivates and encourages workplaces to strive for a high level of safety. The Forum also promotes the zero accident concept by organizing national and regional seminars and providing materials and tools for workplaces. During the 2008–2012 review period, the occupational accident frequency of the Forum's member workplaces (an accident being defined as resulting in at least one day's absence) had decreased by 46%, while accident frequency at the national level over the same period decreased by 7%. The average accident frequency of workplaces that reported accident data to the forum in 2012 was approximately 15 accidents per one million working hours. In 2015 the forum will develop its activity to the next level to better respond to the member workplaces' needs. A new web portal is developed to support more effective communication and learning within the network. The development process of the portal is conducted by using Scrum, an agile software development method. Scrum is an iterative and incremental development process, where a development team works closely together for a common goal and is able to respond to emerging requirements quickly. It means that the future users of the web portal are closely involved in the development process. The portal's main feature will be a communication platform, which will offer a possibility to exchange best practices, and provide information on topical safety news, research results, and related events. It will provide a place for the workplaces to share their experiences and examples of their OHS work. The portal will also include a feature where the workplaces can enter their safety records and actions. Based on this safety data the workplaces are able to apply for the Zero Accident Forum's annual Safety Level Certifications. All features of the portal will provide possibilities for the members to benchmark their methods and results. The portal will support the Forum's main function: networking between workplaces and learning together. It will offer a match-making function, a place where workplaces can find others in similar situations and contact them to exchange knowledge on challenges and best practices. With the new portal the Forum is able to provide better support for the OHS professionals in the member workplaces - to help improve their knowledge and competence. The Forum also wants to support the workplaces in developing an internal network around OHS: to invite also the HR, communication and other functions within the workplace to join in the work for safer and healthier workplaces. In the presentation we will present cases by which we will illustrate the benefits the new web portal brings to communication, learning and benchmarking within the network.

# Safety culture self-assessment - the way forward?

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**Keywords:** Safety culture; Self-assessment; Action research; Insight

## Abstract

Safety culture is here to stay. Who could have predicted that the concept would gain such popularity when it was coined nearly 30 years ago, right after the Chernobyl nuclear disaster? However, it turned out that it fitted quite nicely in all these curves depicting the downward trend in accidents and the accompanying measures. Measures that started with an improvement of technology, followed by an attention for human factors (competence, ergonomics) and then the era of safety management settled in. And in its wake safety culture appeared. Despite its popularity, there is still enough confusion about the concept. Not without reason, though. Safety culture is a challenging concept and deciphering it is a craft rather than strictly applying a particular method. Or is it? Can't we just distribute a questionnaire and analyze the data? Opinions differ on this point and on the issue whether cultures are dots within a multidimensional space, or each spanning their own space, their own dimensionalities. And what would be the purpose of such an assessment? Do we assess safety cultures for their own sake, or are we going to work with the results? And what does this mean? This paper discusses a safety culture self-assessment (SCSA) method, which has been developed and applied by the International Atomic Energy Agency (IAEA). The idea is that a self-assessment is a way of 'working with safety culture', a way of getting to know yourself as an organization. Although this insight might be considered valuable in itself, it is perhaps also necessary for any kind of improvement. That is, getting insight into cultural patterns that sustain many behaviors within the organization is a first step in adjusting these patterns to more safety, more reliability, more resilience. The approach is as follows. A nuclear facility applies for an SCSA-training at the IAEA. A team of experts comes in and provides a three-week training to a team of safety culture ambassadors, as they are called. After the training the ambassadors set out to work in the (nuclear) organization. After about a year, the experts are flown in again and walk through the assessment with the ambassadors. Cultural themes are identified and compared with the IAEA framework. Evaluations are made as to how the organization compares to the framework. In the mean time, the ambassadors have gained insight into their organization's cultural patterns. They might even have suggestions on how to break through some of these patterns. Currently, four organizations have applied for the training and carried out a self-assessment. The first results are promising, although the process is not as easy as it sounds. Often highly technical people are suddenly supposed to work with 'vague' and 'fluid' concepts such as safety culture. People who are used to numbers and reading out instruments are suddenly confronted with subjectivity, relativity and interpretation. Nevertheless, after a first phase of uneasiness, ambassadors often embrace the safety culture concept and its richness. They start to see the patterns of their organizational culture and how these might come in the way of safety. They are beginning to see the light.

# Challenges transferring regulatory regimes. The Norwegian - Brazilian case

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**Keywords:** Transferring Regulatory Regimes; Norway & Brazil; Petroleum

## Abstract

The paper addresses challenges that occur when elements of a regulatory regime developed under certain historical contexts in one region are transferred to other national contexts. On February 11th 2015, there was a serious explosion on the Floating, Production, Storage and Offloading unit (FSPO) Ciade de Sau Mateus on the Brazilian continental shelf. 9 workers died because of the accident. The explosion was however not powerful enough to affect the large amount of oil that was stored on the vessel, which luckily prevented further fatalities and a potential large oil spill. The FSPO was owned and operated by the Norwegian company BW Offshore that produced oil for the state owned Brazilian company - Petrobras. Accordingly, the accident also attracted attention to the relationships between the Norwegian and Brazilian petroleum industry and to how Norwegian experiences have been utilised in developing an offshore sector in Brazil. When Brazil established an independent regulatory institution to oversee oil related activities in 1997, the regulatory approach in the Norwegian offshore oil sector was one of the main models. As opposed to the prescriptive regulatory system in the U.S. Gulf of Mexico, Brazil chose to rely on the Norwegian/British performance based system. However, important formal as well as informal and context related elements of the Norwegian and British system were not implemented on the Brazilian petroleum sector. While many risk regulating regimes are characterised by "Command and Control" with a top-down approach where regulators demand that the industry comply with the rules that they set down, Norway and UK follow principles of enforced self-regulation thereby relying on the capability of the industry to manage their own risks according to accepted norms and standards. Detailed and prescriptive rules provide few incentives for enterprises to engage in innovative practice, and bind them to the established technology and organizational solutions. The more prescriptive rules and technical standards the regulator takes as legally binding, the more responsibility and greater "burden of proof" are imposed on themselves. In a system of "enforced self-regulation" based on voluntary technical standards, and linked to legal standards, compliance with requirements to implicit norms and written in the legal standards become the responsibility of the enterprises. Requirements formulated as legal standards follow developments in technology and societal demands. But their interpretation requires continuous dialogue between the relevant actors in the sector. From legal history we may learn that the development of legislation under the common law principle requires a very active "legislative zone", in which different parties may claim their interests and independent bodies, typically courts, sort out the disputes. The roles and tasks of the regulator and the regulated need to be clarified when combining top-down and bottom-up approaches. In reliance upon functional, risk-based requirements formulated as legal standards, the role as rule-maker should be separated from the role as controller. A decision from the "combined" rule-maker and controller should be able to be appealed to a superior, independent body before they are brought to the court. A division between the different aspects of regulatory functions (legislative, executive and judicial) is not only of high value regarding legal protection of individuals and enterprises, but may also stimulate the necessary dialectics to support a regulation based upon continuously developing legal standards to live up to the best practice in safety management at any time. Accordingly, the main objectives of this paper are two-fold: Through a comparative analysis, the paper discusses similarities and differences in relation to regulatory challenges overseeing the Norwegian and the Brazilian offshore sector. In order to accomplish such an analysis, the paper also relates cases of the Brazilian regulatory system to relevant cases of the U.S and British regulatory system.

# Commitment to zero accident vision and success factors of safety communication

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## Abstract

Introduction Zero accident vision (ZAV) promotes the adoption of a high standard of safety culture and a 'vision zero' concept in all sectors of work life. It is based on the firm belief that all accidents are preventable – if not immediately, then certainly in the long run. The ZAV research project was carried out in seven European countries (Belgium, Denmark, Finland, Germany, Netherlands, Poland, United Kingdom) in order to better understand the factors that contribute to successful accident prevention. We investigated companies that have committed themselves to ZAV, and we studied how safety culture, safety learning, and safety communication contribute to this commitment. In this presentation, we focus on the role of safety communication in the commitment to ZAV. Company's commitment to ZAV requires communication of this vision and sharing the belief that all accidents can be prevented. Communication is critical for disseminating organizational safety goals, norms, and beliefs. Without effective communication processes, ZAV cannot be expected to impact on safety performance in everyday work. In this presentation, we will combine the research lines of communication and commitment, and focus on the understudied relationship between communication and commitment to ZAV. The main question is whether or not company and individual safety communication enhance commitment to ZAV on organizational and individual levels. Methods Altogether 8819 employees and managers from 27 workplaces and seven countries responded to a survey, which included 73 questions (four-point likert-scale) on the success factors of ZAV implementation. We computed nine sub-scales related to the three main concepts: safety communication, safety culture and safety learning; and two sub-scales related to zero accident commitment on organizational and individual levels. In addition, interviews with key actors in participating companies provided the context for the quantitative results. Analysis We used multiple regression to study whether communication on the management level and communication on the individual level predict the level of commitment to ZAV. The quantitative analyses were supplemented with the qualitative data from the interviews. The analysis focused on the success stories of and hindrances to safety communication practices. Results The survey results showed that communication explained a significant amount of the variance in the commitment to ZAV. Whereas communication on the management level was significantly related to commitment to ZAV on the organizational level, communication on the individual level was significantly related to commitment to ZAV on the individual level. However, background variables related to company size and sector moderated the extent to which the two dimensions of communication predicted the level of commitment to ZAV. In the presentation, we will provide more detailed analysis. On the basis of the qualitative data, we will present what kind of successful communication practices companies have for disseminating safety information and creating commitment to ZAV. The preliminary findings show that effective safety communication is e.g. regular, open, dialogue-based, and empowering. Successful practices are based on symmetric two-way communication. Conclusions Our results show that communication enhances the commitment of organizations and individuals to ZAV. To create this commitment throughout the workplace, routinized practices in safety communication are needed.

# A sociotechnical perspective on risk regulation and tripartite system in the Norwegian petroleum industry

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**Keywords:** risk regulation; tripartite; Power; trust

## Abstract

This paper addresses the dynamic of the tripartite collaboration in the Norwegian petroleum industry, by highlighting developments and challenges related to regulation of safety and reliability, and issues of power and trust. The paper is based on findings from the ongoing projects 'SAFERA STARS - Socio Technical Safety Assessment within Risk Regulation Regimes', and 'Robust Regulatory Regimes. Defences against Major Accidents' (Funded by SAFERA & NRC-Norwegian Research Council) During nearly 45 years of oil and gas production, the Norwegian petroleum industry has established a risk regulation regime following the Nordic welfare model of a tripartite system of collaboration, egalitarian values and mutual trust among the main actors (government, operators/suppliers and unions). Through close interactions between the Norwegian government, the oil companies, the supplier industry and the unions, the shaping of the regulatory framework has been characterised by shifting alliances, power relations, trust and distrust. Focusing events (such as accidents and near misses) have created policy arenas for change, but also influenced the relationships between the involved actors and created institutional settings for risk and safety regulation. From a sociotechnical perspective, risk regulation of the petroleum industry consists not only of rules and enforcement mechanisms, but also of the institutional environment from overall policy to concrete implementation. This provides a wider picture of how to develop and enforce safety, which includes stakeholders and agencies at various levels, as well as the institutional structures and organisational culture that keep the regime together. While many risk regulating regimes are characterised by "Command and Control" with a top-down approach where regulators demand that the industry comply with the rules that they set down, Norway follows principles of enforced self-regulation thereby relying on the capability of the industry to manage their own risks according to accepted norms and standards. In its welfare state model, Norway, promotes a symmetrical partnership between public agencies and industrial actors, which involves labour unions in parallel with the asymmetric role of sanctioning industry for violation of law. This differs from a command and control regime with regulators requiring that industry must comply with the regulators' rules or be punished. The aims for the paper are threefold: 1. What characterises the development and challenges of the tripartite regulatory system within the socio-technical framework of the Norwegian petroleum industry? 2. How are focusing events influencing and challenging the sociotechnical character of the Norwegian petroleum risk regulation regime? 3. How are issues of power and trust affecting the sociotechnical character of the Norwegian petroleum industry? Through the years, the Norwegian petroleum industry has been characterised by a certain amount of stability and durability thanks to the tripartite system's long-lasting cooperation in monitoring and improving safety and reliability. However, such processes are vulnerable due to the comprehensive, frequent and multifaceted patterns of interaction among government, operators/suppliers and unions. Risk regulation requires a balance of power and mutual trust among the intervening actors, which becomes essential and sometimes challenging during periods of innovations and changes that have impacts on safety. The paper will thus pursue an analysis where different views among operators/suppliers and unions concerning the risk picture and sociotechnical issues are considered, in addition to situations where the foundations of the tripartite system are threatened.

# An engineering or human approach? A study into employee's perceptions regarding the effectiveness of occupational road safety initiatives

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**Keywords:** Safety Culture; Risk Management; Countermeasure Effectiveness

## Abstract

**Background and Aims:** A range of risk management initiatives are increasingly being introduced in many motorised countries to improve occupational fleet safety, including: driver training, driver monitoring via intelligent transport systems, education and awareness, purchasing safer vehicles, audit procedures, post incident investigations, assessment of health and fitness to operate vehicles, etc. Such interventions often incorporate frameworks aligned with safety culture and climate, in an attempt to maximise safety outcomes. However, considerable variation has been documented in various interventions' ability to create lasting behavioural change, and the frequency of application is not always based on scientific evidence regarding effectiveness. While research has shown that community perception of road safety countermeasures do not always align with evidence, employees' perceptions regarding the effectiveness of fleet interventions has been almost entirely overlooked. This is a critical oversight as employees' beliefs and acceptance levels can ultimately influence levels of effectiveness, and this study aimed to examine such perceptions in Australian fleet settings. **Method:** 679 employees sourced from four Australian organisations completed a battery of questionnaires that focused on self-reported driving behaviour (e.g., Driver Behaviour Questionnaire), a safety culture questionnaire as well as perceptions about the effectiveness of 35 different safety initiatives. These initiatives were based on best practice in industry reports as well as countermeasures that had previously been empirically evaluated in the literature. These included: monitoring driver behaviour, signing commitment cards and encouraging self-monitoring of driving behaviours. **Results:** Countermeasures that were perceived as most effective were: (a) purchasing safer vehicles, (b) investigating serious vehicle incidents and (c) practical driver skills training. In contrast, least effective countermeasures were considered to be: (a) signing a promise card, (b) advertising a company's phone number on the back of cars for complaints and compliments and (c) communicating cost benefits of road safety to employees. No significant differences in employee perceptions were identified based on age, gender, employees' self-reported crash involvement or employees' self-reported traffic infringement history. However, a significant difference was observed between employees in regards to the number of kilometres driven annually for work each year ( $F(7, 574) 2.25 = p < .05$ ). Post hoc tests revealed that initiatives relating to raising employee awareness and motivation to drive safely were perceived to be significantly more effective by employees who drove between 10,001km and 20,000km ( $M = 3.23, SD = 0.78$ ) as compared to employees who drove between 30,001km and 40,000km ( $M = 2.84, SD = 0.75$ ) ( $F(7, 574) 2.25 = p < .05$ ). Importantly, participants who reported higher levels of perceived safety culture in an organisation also reported significantly higher levels of fleet countermeasure effectiveness, particularly in regards to countermeasures that focused on human resources rather than engineering-based approaches. **Conclusion:** Taken together, employees believed occupational road safety risks could best be managed by the employer by implementing a combination of engineering and human resource initiatives to enhance road safety. This paper will further outline the key findings in regards to practice as well as provide direction for future research to identify methods to improve fleet safety through promoting safety initiatives and minimising driver risk.

# Social identity in the construction industry; implications for safety perception and behaviour

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**Keywords:** work-related injuries; safety management; group dynamics; interviews

## Abstract

**Abstract Background and aim:** The construction industry has one of the highest frequencies and rates of work-related injuries, yet the evidence for successful attempts to reduce injuries is generally disappointing even though. Even though the main causes of accidents during construction are well-known (e.g. falling from heights, contact with falling or collapsing objects etc.) and many barriers to safety have been identified (e.g. the dynamics of the building process, the temporal nature of construction projects etc.), injury rates are still too high and do not seem to have decreased significantly over the last 30 years, thus underlining that the construction industry still is a dangerous sector. One explanation for this lack of success may be that the social and psychological dynamics at the construction sites, especially in and amongst the work crews, is not taken into account when safety measures are implemented. Thus, essential aspects of what it means to work on construction sites may be left out. The current study investigated the motivational and safety behavioral implications of social identification and social categorization among construction laborer work crews, and their interaction with the social structure and organization of work at large construction sites. **Methods:** Semi-structured focus-group interviews combined with 15 days of observations during work, were carried out with 13 all-male concrete work crews (in all 53 workers) at five large construction sites. **Results:** The organization of work at large constructions sites fosters social identification within a crew, which causes distancing and social categorization of other crews and site management. The social identification and categorizing influences safety behavior in the crews, where safety rules implemented from site management may meet resistance, and crew norms of rule-breaking/bending may increase. The results show that the organization of work at constructions sites fosters social identification at the crew level, which causes social categorization of other crews and site management. **Conclusions:** To avoid threatening the social identity of concrete work crews, future safety initiatives at large construction sites could involve the crews in decisions regarding planning and implementation of work, health and safety, and provide mediums to break down communication and cultural barriers between concrete work crews, other crews and site management. This study provides evidence that if safety initiatives threaten the way work crews define themselves and their shared goals, the behavioral response may be resistance. Therefore, future safety initiatives at large construction sites may be more successful if they take into account the dynamics of social identification and categorization. This may be done by incorporating insights from social identity theory in the planning and implementation of safety measures, e.g. by creating an alternative organization of work at large construction sites, thus making it easier for the crew to identify themselves with the company. When designing and implementing safety initiatives construction site/crew managers should consider how safety can become a salient and valued group norm, for instance by changing the social structure at the sites or fostering dual identity. This study shows that social and psychological dynamics may have a strong influence on safety behaviour of concrete work crews at large construction sites. Safety management has been lacking in much of the current safety research, and may explain why previous attempts at improving safety at large construction sites often have been unsuccessful.

# Achieving safety compliance through safety leadership

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**Keywords:** Leadership; Compliance; Regulated Environments

## Abstract

Leadership is always exercised within a particular context, yet the context is frequently ignored despite calls (e.g. Osborn et al., 2002; Porter and McLaughlin, 2006) for greater attention to be given to the context within which leadership is enacted. Studies of safety leadership conform to this pattern, rarely considering the context and its impact on leadership. Regulations are an integral component of an organization's safety environment and ensuring compliance with these regulations is a key aspect of the safety leaders' role. Yet compliance is complex, flexible and dynamic and also depends on context (Hutter, 2011). Most organizations are never inspected and most employees never meet a regulator, and consequently the knowledge and understanding of safety compliance requirements often varies across the organizational hierarchy, such that board members, managers, supervisors and front-line workers may all have different perspectives on what is actually required (Gray and Silbey, 2011). Moreover each of these groups has a different capability and motivation to comply. This paper has two objectives. First, it will review existing safety literature on safety leadership practices examining how different modes of leadership support different motivations for employees to comply with safety regulations. Second, it will review the wider leadership literature and suggest how these newer conceptualizations of leadership engender a different form of safety compliance by employees. Deploying the systematic literature review methodology developed for Management and Business Studies (Tranfield et al., 2003) we identified 21 academic articles and 18 policy reports that explored the role and practices of safety leaders. Two particular safety leadership perspectives were prominent (Lekka and Healey, 2012). The first perspective describes safety leadership as transactional (Zohar, 2002), which is either constructive, offering material rewards contingent upon satisfactory performance, or corrective, monitoring individual performance against standards, detecting errors and correcting them. Drawing on employee's instrumental concerns and utility maximization goals, this leadership approach ensures safety compliance by command-and-control (Tyler, 2006). The second perspective describes leadership as transformational. Leaders display four different behaviours that characterise value-based and individual interactions (Kapp, 2012; Hoffmeister et al., 2014). These stimulate an individual's internal motivation towards safety encouraging compliance by self-regulation (Tyler, 2006). Although not evident in the safety literature, two other forms of leadership are commonly considered in the wider management literature, namely Technical-Adaptive leadership (Heifetz and Laurie, 1997) and 'plural' forms of leadership (Denis et al., 2012), including shared and distributed leadership. These perspectives on leadership look beyond the dyadic relationship of leader-follower to embrace the opportunities provided by the collective and the wider context to ensure safety compliance, rather than drawing solely on individual motivation. Silbey (2011) develops the notion of the "sociological citizen" as a pragmatic actor who acts as a link in a complex web of unfolding transactions and processes managing safety practices through relational regulation to ensure situated actions broadly conform to the more abstract rules of regulatory specification. Based on this broader view of motivations for safety compliance, the paper will suggest alternative leadership practices for safety compliance in different, but commonly experienced, organizational contexts. In addition it will highlight opportunities for further research in the leadership of safety compliance. References Denis, J-L., Langley, A. and Sergi, V. (2012). Leadership in the plural. *The Academy of Management Annals* 6(1): 211-283. Gray, G.C. and Silbey, S.S. (2011). The other side of the compliance relationship. In: *Explaining Compliance: Business Responses to Regulation*. Eds C. Parker and V.L. Nielsen. Edward Elgar: Cheltenham, UK. pg 341-369. Heifetz, R.A. and Laurie, D.L. (1997). The work of leadership. *Harvard Business Review* 75 (1): 124-134. Hoffmeister, K., Gibbons, A., Johnson, S., Cigularov, K., Chen, P. and Rosecrance, J. (2014). The differential effects of transformational leadership facets on employee safety. *Safety Science* 62: 68-78. Hutter, B.M.



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# The sociotechnological view of industrial safety

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**Keywords:** sociotechnological; safety; accidents

## Abstract

As part of the European project STARS (Socio-Technological Assessment in Risk Regulation regimeS), this presentation wishes to come back on the meaning of a 'sociotechnological' view of industrial safety. In March 2011, a tsunami in Japan hit and passed over a wall that was designed to protect the nuclear power plant located behind it. But the wall was too low. Water flooded the premises where backup batteries were located, and a loss of electric power occurred as a consequence. Without power, the process operators, engineers, managers, regulators, media, officials and civil society act in face of the behaviour of a complex system that they have never experienced under these specific circumstances. Meltdown of the core of the reactor ensued. Thousands of people were evacuated and the environment contaminated. In April 2010, highly flammable pressurised gases from deep geological layers shot up to an offshore platform, forming a cloud which ignited and exploded. The measures designed to prevent such an event, including a blow out preventer (BOP), did not function as intended. The purpose of such a device was to cut the line connecting the offshore platform to the well in order to stop the gas from reaching the platform. Several people were killed, the platform sunk, and a pollution followed. Operators, engineers, managers, authorities, regulators, shareholders, media and civil society faced the biggest oil pollution of US history. In June 2009, sensors indicating speed in the Air France aircraft flying from Rio to Paris got frozen and sent wrong indications to pilots. The aircraft was going through a well known storm area. Manual handling of flight by pilots in these circumstances is then impaired by interface design issues conveying contradictory information to pilots about aircraft's status. The crash left no survivors and became the deadliest crash in the company's history. To make sense of such events, disaster and safety research has been steadily producing a diversity of concepts, models and studies over the past thirty to forty years from a diversity of disciplinary backgrounds (psychology, ergonomics, management, sociology) and safety-critical systems (aviation, nuclear, railways, chemical). As a consequence, one encounters a range of 'research traditions' and key topics mixing together graphical, metaphorical and analytical insights. Safety Culture, Safety Management, High Reliability Organisations, Resilience Engineering, Swiss Cheese Model, are some of this most visible examples which have been framing through specific lenses the issue of expanding our understanding of safety beyond a technologically centred approach. The contention of this paper is that, beyond and throughout this diversity, one can nevertheless extract a consistent background of works which attempt to conceptualise the sociotechnological side to safety by incorporating under this heading a vision interweaving technology, tasks, activities, processes, structure, cognition, power and culture. Based on debates anchored in social theory (among which the micro-macro issue or the materialistic side to society) and interdisciplinary studies (among which the drive for convergence), this move helps to shape a new generation of safety models that take stock of the managerial, social and political dimensions in our effort to understand and prevent disasters in a world of accelerating and globalised changes. The presentation will introduce the main arguments supporting this sociotechnological thread.

## Stars 'common study protocol': describing the French risk regulation regime

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**Keywords:** risk regulation regime; sociotechnological view of safety; authorities

### Abstract

The aim of the presentation is to apply, as part of the European project STARS (Socio-Technological Assessment in Risk Regulation regimeS), a 'common study protocol' (CSP) which has been specifically designed to compare Finish, French and Norwegian risk regulation regimes (RRR) of chemical, petrochemical and petroleum activities. This constitutes the first milestone of the project. The protocol contains 10 items which requires in depth data collection to frame consistently the many dimensions which have been considered relevant by the project consortium (University of Stavanger, Norway; INERIS, France and VTT, Finland). These items are: 1. The size and composition of the regulated industry; the size and composition of the regulatory body, background, competence, scale. 2. Development and trends of the industry in terms of technology and hazards, new technological innovations (e.g. integrated operations). 3. Responsibility and accountability for safety and accidents; legal responsibility, organizational versus individual responsibility. 4. Legal framework (connection to government, political system & influence). 5. Espoused regulatory strategy (prescriptive, functional / self-regulation, ALARP, ALARA), basic definitions (risk, safety, uncertainty). 6. Structure of regulators' organizations, ways of organizing, and managing, trends. 7. Participation, who is participating and about what (tripartite, etc.), who has power and who does not, who knows whom and interacts with whom. 8. What types of inspections, how regularly, what is inspected. 9. Types of assessment methods and formalized indicators, what type of analysis is done (risk assessment ideology behind them). 10. How rules are produced. Challenges with the CSP is first to find relevant sources to gather data for each of the item, second, to adjust the level of depth to be developed for each item (in relation to the availability of data) and third, to describe items in a way that is consistent with the purpose of the project. When taking into account these challenges, the presentation of the French case study based on the CSP offers a unique perspective on a RRR which had never been described from such a wider perspective. A similar situation is met with the two other cases (Finish, Norwegian). The CPS provides condensed and very useful overview. But, once this material is gathered, a certain number of difficulties have to be addressed in relation to the aim of comparison between regimes. The results of this comparison are presented and reflected in relation to the purpose of providing ways for RRR to better harness the sociotechnological nature of industrial safety. Early outcomes of this process reveal interesting contrast between Finland, France and Norway, including the recruitment of inspectors, the size of the industry regulated and the type of interactions between industry, unions, state and civil society. These contrasts indicate different contexts in which the prospect for alternative approach to RRR through a sociotechnological assessment of high risk systems can unfold. Part of the context includes the sociotechnological view produced by safety research which has been producing a diversity of concepts, models and studies over the past thirty to forty years from a diversity of disciplinary backgrounds (psychology, ergonomics, management, sociology) and safety-critical systems (aviation, nuclear, railways, chemical). This abstract includes 4 different presentations. One presentation for each research partner introducing the application of the CPS to their RRR, and one common presentation about outcomes of comparison (including difficulties, insights).

# Assessing team collaboration in emergency response during simulation exercises in aerospace vehicle launching

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**Keywords:** aerospace; ergonomic work analysis; emergency response; simulation training

## Abstract

Safety management, risk control, and emergency response are major challenges for organizations who deal with high risk technologies such as the Aerospace industry. People in aerospace organizations perform highly complex and risky activities before and during aerospace vehicle launches. These activities have a potential for the occurrence of incidents and even major accidents with impact on human life, the environment, and high financial on the organizations itself. The Brazilian space program suffered a major impact with the accident in Alcântara Launch Center (CLA), in Maranhão in 2003, which killed 21 people, including technicians and engineers of the technical-scientific body involved in the Satellite Launch Vehicle Project (VLS). Beside (and because) the dead of highly skilled technicians, this accident caused a major delay in the scientific development of Brazilian aerospace industry. This study analyzes the team collaboration and its main features - communication, cooperation and coordination - during the simulated training for emergency response in an aerospace launching facility. The aim is to propose recommendations for the organization training system to improve the collective skills and resilience of the emergency response team. The method is based on ergonomic work analysis-EWA framework that combines observational and interactive techniques to capture and record work activities during training situations. The analysis was carried out during several training exercises of the emergency response team of the aerospace facility. The emergency response team is composed by firefighters, rescue workers and medical staff. The organization was the Barreira do Inferno Launch Center (CLBI), located in Parnamirim - RN, Brazil. The relevance of this research can be characterized as a way to improve training system for emergency response, minimizing the human and material damage resulting from eventual accidents in aerospace vehicle launching operations. The scientific contribution is to show how EWA framework can be used to analyze emergency response actions, a work situation that cannot be directly observed. Therefore some adaptations in the EWA framework were needed to transfer the results obtained from the observation of the simulation to actual work activities. It is also important to note that the improvement of simulated training exercises for emergency response actions in launch operations of aerospace vehicles are paramount for the current recovering process of the Brazilian space program. The assessment indicated problems were identified in the exercise planning issues and in the response actions itself, with regard to communication, cooperation (between members of the emergency team and these with the other agents involved in the release operation), and the coordination of actions. It was concluded that these problems are arising, mainly because organizational and planning issues of the training. After the assessment the recommendations are: a) a new simulated training model consisting of scenarios based on postulated abnormalities with significant realism, to train and improve communication, coordination, and cooperation of the emergency response team actions; b) restructuring and reorganization of the current training system, c) creation and formal designation of a specific planning organization composed by a training manager, d) a program for training facilitators, the clear division of responsibilities, e) standardization of training processes: development of training indicators, continuous monitoring, the feedback of the quality of training and continuing training of emergency responders.

# Mindsets of cultures of prevention

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**Keywords:** Vision Zero; Culture of Prevention; Globalisation

## Abstract

Occupational health and safety are under development for now approximately 200 years, accompanying the different steps of the “industrial revolutions” in the post-agrarian world of work. The first industrial revolution in England, Western Europe and the USA with its far-reaching and permanent change of working and living conditions made social reforms necessary. These reforms included precautions for safe work. In the second phase of industrialisation Fordism became the dominant method of production for much of the 20th century, identified with mass production and assembly-line technology. Fordism was characterized by large-scale semi-skilled workforces, standardized production, and work control via “scientific management” (Taylorism). In these more complex and process-oriented work structures social changes of the society became more and more urgent and lead finally to the intensification of safety at work. With the beginning of the information era in the 1970ies and 1980ies health became an object of consideration in the context of work. Nowadays the economically “advanced” countries are on their way into the next era, the fourth industrial revolution based on technological concepts of cyber-physical systems, the Internet of things and the Internet of services”, including a mostly complete digitisation of most work processes and the development of “smart factories”. The first approaches of prevention at work targeted mainly on technical aspects at the workplaces like safe machinery, safe engineering, safe equipment and safe working material. This approach was followed by organisational optimization and the development of detailed legal frameworks. That was in principle the approach of establishing a safe working environment at the workplaces, the measures were predominantly executed by the employer and the “receivers” were the employees. A next step was to try to change the often unsafe working behaviour of employees in terms of informing, instructing and enabling them to work in a safe manner. The sender of safety information were again the employers, the receivers the employees. In cases where technical and organisational measures are not sufficient, the use of personal protective equipment might be a means of protecting the physical integrity and health of working people. On the way of developing a holistic and modern working environment it became indispensable to include the preservation and enforcement of the health of the working people in prevention means and measures to the point of workplace health promotion. Recent efforts are to achieve a culture of prevention – often by use of strategies e.g. the “Vision Zero”. This attempt tries to implement health and safety in the whole life, to establish a culture of prevention in the whole society, health and safety - more or less literally - from the cradle to the grave. But what is a culture of prevention against the background of diverse societies, globalisation and its accompanying developments? Would a culture of prevention be the same for people working in Germany, Italy, Korea and China or are there different relations, which require different and suitable approaches? Are there and if yes, what are the different receptions with regard to “culture” besides all technical means, organisational measures and personal requirements?

# Effective risk assessment of major accident: case study of LPG storage risk analysis

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**Keywords:** Major Accident Prevention; Risk Assessment Methods; ARAMIS; LPG

## Abstract

The goal of this contribution is presentation of the risk assessment and management of risk sources in industrial enterprises. The main part of the paper will deal with so called unclassified risk sources, i.e. LPG storages, especially in small and medium-sized enterprises (SME). The evaluated SME are characterized as risk sources with an amount of dangerous materials under the limits of the SEVESO III Directive that could represent, as a result of the area location or specific process activities, significant major-accident risks. The major-accident prevention of these risk sources is not specified in any law at present, and that is why any adequate pressure is put neither on the assessment, nor the reduction of risks. Therefore, one of the goals of the article is to increase awareness on these unclassified risk sources, because risk perception is one of the main influencing factors within accident prevention. In view of the growing prices of petrol and oil, the interest of drivers in liquefied propane-butane (LPG) as a fuel for cars rises. The number of storage tanks for car filling, both stand-alone tanks and tanks as part of petrol filling stations, increases. Prevention of accidents associated with LPG storage facilities is a priority in the protection of people in the vicinity of the facilities and equipment and forms an integral part of the management of system safety. The aim is to contribute to the prevention of accidents and incidents of process equipment with LPG based on the analysis of possible scenarios of accidents of LPG storage tanks and on the assessment of risks. Equipment with propane-butane (pressure vessels, tanks for heating) together with its transport by road and rail represents a significant number of risk sources. New LPG filling stations are built, but the issue of distances between them and petrol filling stations has not been sufficiently solved yet. During normal operation, fuel filling stations are not regarded as significant sources of risk in spite of the fact that from statistical data a certain level of major accident risk follows. In case of accident, a so-called domino effect, when an accident of one piece of equipment may cause a major accident of another piece of equipment, has to be considered. Risk assessment can be carried out by quite a number of methods developed by modifying several most widely used methods. For the case study methodology ARAMIS ("Accidental Risk Assessment Methodology for Industries in the framework of the SEVESO II directive") was used. ARAMIS was developed in the framework of an EU project. ARAMIS is a harmonised methodology for risk assessment, aimed especially at reducing uncertainties and variability in results of risk analysis and at inclusion of the evaluation of risk management efficiency into the analysis. ARAMIS presents a comprehensive tool for efficient implementation of risk identification and analysis which could be efficiently used within major accident prevention. The ARAMIS methodology uses logical graphs - fault trees and event trees – for the preparation of accident scenarios. It was justly selected for the analysis and assessment of risks associated with the LPG station.

# Developing safety and risk management in mobile work: focus on organizational learning practices

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**Keywords:** mobile work; risk management; safety; organizational learning; resilience

## Abstract

Introduction From the safety perspective, resilience is about looking for ways in which to expand the organization's ability to create processes that are robust and flexible, even when threatened. Both employees and organizations have to be able to adapt their actions and performance to varying circumstances. Thus, safety is based on their ability to respond to actual circumstances, cope with critical situations, anticipate potential risks, and learn from experiences: of both success and failure (Hollnagel, 2011). As learning is one of the cornerstones of resilience engineering, we are interested in how risks are anticipated and learning practices developed in today's mobile and multi-locational work settings. Developing learning practices in multi-locational work is a challenge to client/supplier cooperation as well as to their learning systems. The main constructor in network-like, shared workplaces must coordinate risk management jointly with business partners, for example, subcontractors. The aim is that everyone working at the same workplace is not only fully aware of the risks and hazards, but also able to learn from each other. In mobile work, supervisors and employees seldom meet face-to-face, which challenges the traditional ways of communicating and generating shared competence development. This is also a critical feature in creating safe workplaces, i.e. jointly developing safe, effective and resilient work practices. Although mobile work challenges the traditional communication and learning methods, ICT-based, real-time solutions and applications are simultaneously developed to enable mobile work; to make it safe and more productive. Our particular interest is in learning: What kind of learning practices are needed to develop safety and resilience in mobile work? To explore the issue, we study the work of service technicians in a Finnish maintenance organization, who work in shared workplaces at different clients' premises on a daily basis. Their work has become increasingly ICT-bound in recent years, and they meet supervisors and colleagues less frequently. We focus on the perspective of both the individual and the organization: How do service technicians share their experiences of success and failure, and how do the organizational learning practices support their learning? Our presentation is based on the Supporting organisational resilience in complex adaptive systems (ResCas) project. The goal of ResCas is to identify and describe the organizational practices and individual capabilities that contribute to organizational resilience. Data and methods Our data consist of workshop discussions in which the service technicians and their supervisors jointly analyse work practices. The focus is particularly on anticipating and managing risks in mobile work; how the safety and well-being of service technicians' everyday work is ensured and promoted. The workshops are facilitated by the researchers and the implementation of the workshop is based on the Vygotskian idea of double stimulation: Researchers collect data through interviews and ethnographic observations, and select the relevant data to mirror actual work situations, disturbances and success stories. The mirror data serves as the basis for collective analyses, i.e. modelling and developing new work and learning practices. Results In our presentation, we will provide the preliminary findings of our ongoing project. We will provide a detailed analysis on service technicians' learning challenges in mobile and multi-locational work. We will also create an understanding of how the organization's learning practices can support the creation of resilient organizational capabilities, and discuss how learning practices can be developed; Where and how does learning take place? References Hollnagel et al, Resilience Engineering in Practice, a guidebook, Ashgate 2011

# Risk prevention for adaptive work assistance systems and human-robot-collaboration using individual digital human models

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**Keywords:** anthropometry and (occupational) biomechanics; digital human models and digital ergonomics; risk prevention for human-robot-collaborations; adaptive work assistance systems; demographic change

## Abstract

**Introduction and motivation:** The prevention of occupational health risks and damages with respect to adaptive work assistance systems and human-robot-collaboration serve as a prerequisite for a human-centered, ergonomic and safety oriented planning within industrial production. The individual adjustment of adaptable workplaces as well as assistive work systems tries to account for different characteristics of an employee. This individual approach is motivated by the demographic development throughout Europe and its consequences that need to be addressed to ensure the well-being of the ageing workforce as well as the economy. A decline of the working age (15-64 years) population (67% to 56%) (EU aging report, 2012) and a substantial increase of the work-force over 50 years by 2060 are predicted (DeStatis, 2013). Musculoskeletal disorders hold responsible for 23.4% of the expenses and loss of production due to work inability (BAuA, 2014) and several physical performance parameters must be considered with respect to the their increasing intra- and interindividual variance (Hollmann & Hettinger, 2000). Especially anthropometrical and biomechanical parameters such as the age-related change of the maximum achievable ranges of motion in human joints should be included in early stages of the planning process. To address the issue of individualization and to ensure an optimal allocation of tasks regarding person specific parameters and corresponding strain values, digital human models are used in the virtual planning and simulation. Especially for direct human-robot-collaborations, the virtual planning of joint workplaces of men and robots becomes increasingly important (Busch et al., 2013). While using digital human models for a prospective planning of the future workplace design, their individualization is still a subject that needs thorough investigation in order to focus on the issue of risk prevention in human-robot-collaborations. It also entails the integration of safety- and health-protection requirements directly into virtual product-development tools (CAD, virtual-reality systems). The "INDIVA" research project: The research project "INDIVA – Individual socio-technical workplace assistance for industrial production" aims towards a human-centered workplace design via the individualization of semi-automatic assistive hybrid robotic systems with a flexible degree of automation. One of the project's main focuses is the realization of an ability orientated allocation of tasks between the human worker and the robotic assistant. Digital human models are used and individual and application specific characteristics of the joint workplace for humans and robots are implemented in the simulation of socio-technical and man-machine workplaces and -systems. The project's scientific partners are the Federal Institute for Occupational Safety and Health (BAuA) in Germany and the Institute of Production Systems of the Technical University Dortmund, as well as partners from the industry. The "Human Factors, Ergonomics" unit of the BAuA focuses on the consideration of individual anthropometrical and biomechanical parameters under ergonomic aspects of direct human-robot-collaboration. **Methodological approach:** For the quantitative assessment of worker-specific anthropometric and biomechanical data, a markerless motion capturing setup is used (Microsoft Kinect v2.0, time-of-flight technique). The use of markerless motion capturing techniques enables the direct use in industrial settings. These recorded kinematic data (especially joint-specific ranges of motion) as well as segment lengths can then be integrated into the virtual planning of a direct human-robot-collaboration by the means of digital human models and an offline programming software environment for robots. The recorded worker-specific data will be exported in a suitable data format in order to be stored in a database for individual anthropometric and biomechanical



parameters ("i-databiom"). This workflow allows for an intuitive and easy data access for the simulation of the human-robot-workplace. Discussion and outlook: By combining the flexibility of manual processes by humans and the high efficiency and repeatability of semi-automated processes, hybrid manufacturing systems benefit from the synergistic effect of human-robot-collaborations. The virtual planning and design of these complex socio-technical work systems can be extended via the individualization of digital human models. In combination with the use of real motion capturing data, this is a promising approach. The parameterization accounts for the need to consider the difference between the demands of work and the worker's physical work capacity when addressing work-related musculoskeletal disorders (Okunribido et al., 2011) and pursue the intention to support older workers at their worksites individually considering their different capabilities and skills (Kumashiro, 2000). The consideration of individual and subject specific physical parameters and the identification of corresponding robot trajectories for the joint collaboration of human and robot will lead to a reduction of the physical stress employees have to deal with when working in an industrial assembly line. It tends towards the prevention of indirect work-related musculoskeletal health risks and injuries in the context of current occupational safety and health issues. Acknowledgement: The presented research was partly funded by the German Federal Ministry of Education and Research (BMBF, funding number: 16SV6253). References: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (BAuA) (2014): Sicherheit und Gesundheit bei der Arbeit 2012. Dortmund. Busch, F., Wischniewski, S., Deuse, J. (2013): Application of a character animation SDK to design ergonomic human-robot-collaboration. Proceedings 2nd International Symposium on DHM. Ann Arbor, USA. European Commission (2012): The 2012 Ageing Report. European Union, Brussels. Hollmann, W., Hettinger, T. (2000): Sportmedizin. Schattauer Verlag, Stuttgart. Kumashiro, M. (2000): Ergonomic strategies and actions for achieving productive use of an aging work-force. *Ergonomics* 43:1007-1018. Okunribido, O.O., Wynn, T., Lewis, D. (2011): Are older workers at greater risk of musculoskeletal disorders in the workplace than young workers? – A literature review. *Occupational Ergonomics* 10:53-68. Statistisches Bundesamt (DeStatis) (2013): Datenreport 2013. Bonn.

# Construction and safety management: a BIM-based framework

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## Abstract

Construction management deals with different problems like the feasibility and interoperability of all detailed design drawings/documents and specific construction methods/specifications, detailed cost estimating based on an accurate takeoff quantity, constructability and detailed constructed schedule, health and safety risks management, among others. Usually it is faced the lack of specificity of all design pieces, and the inexistence of effectiveness and compatibility between construction schedule, safety planning and the construction process. All the construction management process should begin in the early stage of design phase with an integrated vision, because design influences costs, scheduling, safety, durability, constructability, facility management, and any decision made at the initial stage of a project life cycle has greater influence than those made in later stages or during construction phase. Building information modeling (BIM) application is growing in the design and engineering fields, which is a modeling technology and associated set of processes to produce, communicate, and analyze building models. According to ISO 29481-1:2010 is a "Shared digital representation of physical and functional characteristics of any built object (including buildings, bridges, roads, etc.), which forms a reliable basis for decisions". It enables a building to be represented by intelligent objects that carry detailed information about them and also understand their relationship with other objects in the building model. This methodology enables the creation of digital 3D models of buildings with embedded information about a project from design through construction and operation phase. These models are a digital representation of the physical and functional characteristics of a building design. So, it is more than just a 3D virtual model, is a repository of intelligent building objects with attributes and relationships, making it an effective vehicle for automated design decision-making in all the phases of a project. The model can integrate information from different disciplines (such as value analysis, constructability, sustainability, site layout, facilities management). The use of BIM during the entire lifecycle of a building is what is desired in the short term, from design (3D), construction (planning simulation) (4D), costs estimation (5D), sustainability and energy performance (6D), and facility management (7D). At the management level the integrated Knowledge-base BIM system, to monitor the post-construction stage for maintenance management, and to improve processing lifecycle-data that is created/maintained by BIM (e.g. requirements, operational, maintenance and safety information) is also an automated reliable method. Several BIM-based tools applied for attain all BIM dimensions (3D, 4D, 5D, 6D, 7D) have been developed. In spite of this, in the scope of construction management there are not a concern with the production of an integrated framework aiming an overall construction project, including in the 3D model and in the construction planning, the occupational risk prevention and the safety planning. This work has as purpose to present a BIM-based integrated framework that includes in the BIM model relevant information for risk prevention during the construction and use phase. All this information is used during the construction planning simulation, to optimize scheduling both in production and safety aspects. All the relevant aspects also are recorded to be implemented and managed during the building use phase. This integrated BIM-based framework contributes to a design, construction and use phase, with higher safety level, and the potentialities of BIM software are used to obtain optimized results integrating in all the design elements productivity and safety requirements. The BIM model of a building was developed in detail in Revit-Autodesk, a 3D architectural design software. All the product information was modeled in Revit as all the constructive details. A WBS – Work Breakdown Structure for the building project was designed and the construction planning and the construction simulation were done with specific software. This simulation and visualization permit to identify hazards and risks caused by site

constraints, construction sequences, and temporary structures, co-existence of different activities, manpower and machinery. In summary, with this integrated BIM-based framework it is possible to incorporate safety since in the early stage of design and attribute to each detail the safety features and requirements. All this elements are related with construction planning and with the activities that have to be performed during the use phase of the building. It is important to remark the possibility of templates definition that permit the automatic extraction of safety technical procedures, which can be part of the safety plan and of the safety file of the building.

# Using business processes modeling notation to improve learning processes in a high-risk industrial facility

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**Keywords:** learning process in organization; modelling of organizational processes; business processes modeling notation

## Abstract

The health and safety issues are very important aspects of the operation in high-risk plants, like the refineries. One of the relevant elements of safety management is learning from near misses and accidents. Research on learning in organizations is often occupied with the ability of the new knowledge to lead to changes in the relevant settings. We assume that learning also covers confirmation of existing knowledge and gaining deeper comprehension of existing practices at the refinery. Learning processes implemented in refineries could be complex due to the many actors involved (interacting employees) and the performance of learning activities could be highly individualized. The motivation for our research has been to reveal formal and informal learning processes in a European refinery and to provide measures and recommendation to improve learning from near misses and accidents. The visualization of the organizational processes is an established method facilitating the understanding by explicitly presenting the interdependencies between the actors (units) as well as character of those links, e.g. flow of information or communication patterns. The links represent the flow of information, its type and form. However, the application of visualization to the studies of organizational learning is not commonly seen. The novelty of the presented approach is the use of the graphical representation for improving the learning process of learning in the refinery. In order to present the learning processes in the refinery we apply the approach called Business Processes Modeling Notation (BPMN). BPMN visualize interdependencies of the processes and recording of all accident and near miss information in an easy and transparent way. We used BPMN to understand, automatize, optimize and re-engineer the learning processes in the refinery. In this paper we sketch the graphical representation of the learning processes in the refinery at two levels of detail: the whole organization and the department. The graphical representation of the learning process facilitates the understanding of how the process is accomplished, who the stakeholders are and their related roles, how they communicate and what type of information they pass. The graphical representation of the processes enables fast identification of the loops, for example in incidents management processes. The negative impact of the loops on the performance of the processes is related to the fact that any loop requires the repetition of one or more of the activities. The repetition of the activities slows down the whole process and increases the use of the human and material resources. The identification of the loops and their elimination or modification is a method for the improvement of the efficiency of processes. It is worth to note that the loops identified in the process of visualization are a different concept than “the learning loops”. The organizational loop corresponds to the process of repetition of identical activities and involvement of the same actors while “learning loops” assume the change of the information contents by application of the sets of the additional rules or reflection on the learning process itself. BPMN enables the identification of the organizational loops in the process of learning, which is the basis for improvement and simplification of the whole process. The rationalization of information flow inside of an organization will improve the process of learning from near misses and accidents. In this paper we propose a set of performance measures adapted to the BPMN modelling. The assessment of the performance of learning in an organization could for example be done by analyzing the various loops’ abilities to accumulate knowledge, the time needed for this accumulation, the number of employees having access to the knowledge and so on. The aspect of time needed for learning is particularly addressed in this paper in order to provide a deeper comprehension of one of the performance measures based on the empirical data from the refinery.

# Risk assessment for work-related musculoskeletal disorders: matrix-based approach versus quick exposure check tool

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**Keywords:** MSD; Risk assessment; Matrix; QEC tools

## Abstract

Musculoskeletal disorders (MSD) remain the most common occupational disease in the European Union and seem to affect workers in all sectors and occupations. Beside the need to treat workers with MSD, emphasis should be put in prevention with actions directed towards the risk factors. Therefore, it is crucial to perform risk assessments in order to define intervention priorities and allocate resources accordingly to reduce the prevalence of this disease. Resources are scarce among small and medium enterprises (SME) and most of them struggle to comply with legal requirements on occupational health and safety (OHS). It is a common practice within SME to use semi-quantitative methods, particularly those relying on risk matrices, to carry out risk assessments within the OHS context. In most cases, they do not have the resources to apply other sort of methods or hire a consultant. Therefore, this approach turns out to be the available one to perform a risk assessment, namely because it allies the advantages of both the quantitative and the qualitative approaches and overcomes some of their limitations. For this reason, the use of matrix-based risk assessment methods may be useful for the screening stage, although there are different methods, specifically developed to assess MSD risk factors. Afterwards, if these preliminary results reveal a significant risk, a more detailed assessment should be considered. The main objective of this study was to compare the results obtained with four semi-quantitative risk assessment methods (SqtRAM), applied to MSD risk factors, with those of the Quick Exposure Check (QEC) observational tool, in order to evaluate the feasibility of such a screening process. The selected methods included two simple matrix methods (MMS 3x3 and BS8800), which resort to the use of two single variables (Likelihood/Frequency and Severity/Consequence) and two complex matrix methods (MMCP and WTF), which rely on three or more variables. A single analyst applied the QEC tool, and the obtained result was considered the gold standard for the risk of developing a MSD. Forty-four analysts were asked to apply four SqtRAM to estimate the Risk Level in one task accomplished to produce car Airbags. These analysts relied on the same description of the working situation which was complemented with a video. The LimeSurvey® tool was used so that analysts could complete the task from wherever and whenever they would consider it appropriate. Considering that all four SqtRAM integrate a risk index scale with 5 levels of intervention priority whereas the QEC tool risk index scale presents only 4, this last one was extended to facilitate the risk index scales comparison between both approaches. It was possible to evidence the difference between the results obtained with all SqtRAM and those of the QEC tool. The BS8800 was the most adequate method to assess the risk of developing a work-related MSD. The WTF method overestimated the risk of developing work-related MSD whereas the MMCP method underestimated it. Since a single work situation was assessed in this study, it is advisable to reproduce it with other work situations so that a reliable assessment of the matrix-based approach as a MSD risk assessment method can be performed.

# A day in the life of a construction worker

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**Keywords:** toolbox meeting; quantified occupational risk; hazards in construction; working conditions

## Abstract

In the Netherlands in 2011, during reconstruction, part of the stands of a football stadium collapsed, killing two construction workers and leaving fourteen injured. The following investigation showed that some essential safety precautions were overlooked because all involved assumed that someone else had taken care of them. For the building company the accident was the reason to launch a new safety program called WAVE (Be Alert Safety First in translation). Part of the programme is the development of a whole range of tools that could apply knowledge and research about absolute and quantified risk, risk perception, root causes, working conditions and behaviour into practice. Among others a 'serious game' and a film. The film was shot in a week (filming whole days), showing the daily work and interviewing those involved concerning their choices and behaviour, at two major construction sites with multiple (international) sub-contractors present. On site everything looks and seems state of the art with high standards of procedures in place, good equipment and qualified people but still and without any scripting from the filmmakers - even knowing that the camera is rolling - unsafe situations or working conditions can be observed. The film itself gives a very interesting insight in the daily life of construction workers and the project managers and the choices they make on a daily basis and how these affect their and others safety. However we have also identified six themes and selected clips from the film to support these themes for use in a toolbox meeting. The six themes are: 1) Communication 2) Rules 3) Personal Protective Equipment 4) The building chain 5) Trust 6) Falls and trips We have combined these themes with our previous work in the ORCA (Occupational Risk Calculator) and Storybuilder projects performed on behalf of the Ministry of Social Affairs and Employment of the Netherlands. As part of the ORCA project a list of 63 generic hazards (like working on roofs or in the presence of mobbing vehicles) related to various aspects of worker's activities has been identified and the risk to workers in the Dutch population from each of these hazards has been quantified. Quantification of risk requires in general two types of data: a) Number of accidents; b) Exposure of working population to the corresponding hazard. The number of reported accidents during the period 1998-2010 has been assessed from the analysis of the data base of the Dutch Labour Inspectorate (I-SZW), where work related serious accidents are reported under Dutch law. A survey of the Dutch working population performed in 2011, has provided the total time the worker population subject to the reportable system has spent working in activities involving each of the 63 hazards. Part of the project was also the assessment of the quality of over 400 working conditions ('are the brakes of a mobile scaffold employed', 'do people stay inside the cabin of a cherry picker') during exposure and how the quality influences the risk. To underpin the message from the film we've prepared six toolbox sessions using both clips from daily life and our facts and figures. The session have a fixed format where a topic is introduced (like 'rules are made to be broken') with a clip from the film, the number of injuries at the company in 2014 due to the situation is given and questions about risk, risk perception, working conditions of two specific hazardous situations are asked. The session ends with 2 discussion topics for the remainder of the session. This paper presents how we made the film, added the facts and figures and constructed the toolbox meetings. It will also discuss the reception, impact and effect in practice as the film is now being showed and used in construction sites through the land. [If the conference programme allows for an extended session we can show the complete film with English subtitles] [Disclaimer: if this paper is accepted the legal department of the building company might edit the film for public showing]

# Work related traffic safety – the potential of expanding enterprises' HES management to encompass traffic safety issues

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## Abstract

A major part of the traffic and accidents on Norwegian roads are related to transport connected to work. The ISO 39001:2012 "Road traffic safety (RTS) management systems. Requirements with guidance and use", has been issued for increasing safety. The Norwegian Government has adopted the Zero Vision strategy since 1999, which is operationalized by the Norwegian Public Roads Administration (NPRA). This strategy fits very well with the ideas in the ISO 39001, thus the NPRA as a major stakeholder for transport safety has taken an initiative to assess the traffic safety potential in ISO 39001 as a traffic safety measure in Norway. The general Norwegian regulation on health, environment and safety (HES) could become an attractive option for also implementing traffic safety. The study presented in this paper was organized in three major phases. First, we analyzed the ISO 39001 with the aim to address what matters and how would the enterprises adopting the standard be able to influence traffic safety on the public roads. The standard's assumption of possible users, objectives, underlying accident models and recommendations to risk reducing measures were also part of the analysis. Next, we made four case-studies in relevant enterprises from various sectors with the aim to discuss how their representatives responded to the idea to implement a standard like ISO 39001 as part of the HES management. The interviews from the case-studies and the background information were further developed into a Delphi-survey in which 38 traffic safety and HES experts responded. The issues were; 1) Prerequisites for a successful implementation of ISO 39001; 2) tools at hand to implement the standard, 3) possible effects of an implemented standard, and 4) NPRA's role and options related to implementation of the standard in enterprises using the Norwegian public roads. The major findings are as follows: There is a traffic safety potential in the enterprises' self-realization and knowledge of their need to manage traffic safety. Traffic safety management must be perceived as meaningful, thus measures that increase the knowledge, measures that increase leadership engagements, success stories and customer requirements and incentives, are needed. Customers are important stakeholders. If the customers demand traffic safety through ISO 39001, this will be a powerful prerequisite. Important stakeholders, such as the NPRA, the Police and the Norwegian Labor Inspection Authority, must be good role models. The effect of implementing ISO 39001 could be measured through intermediate factors, such as increased work satisfaction, reduced fuel consumption, reduced maintenance and operational costs, improved quality of vehicles and equipment, better speed adaption amongst road users, increased use of safety equipment in vehicles, and generally improved traffic safety knowledge amongst road users. The NPRA has many options to influence the implementation of ISO 39001, e.g. through their development of regulations, contracts with entrepreneurs, consultancies, vendors etc., internal HES work, collaborations and networking activities in sectors, and aiding tailor-made traffic safety management packages for various businesses. We conclude that ISO 39001 represent an interesting opportunity in the Norwegian context of traffic safety work. Internal control principles have been in place in Norwegian enterprises for more than 20 years and road traffic safety is getting societal foothold as an important value. However, the driving forces for implementation of a traffic safety standard in enterprises must become much more visible for enterprises being the dominating stakeholders in the road traffic system. In real competitive life, it is difficult for managers and employees to internalize the philosophy "traffic safety is part of everything we do". Thus, the premises for easy implementation and related benefits must be carefully considered. Here the NPRA plays an important role being the traffic safety coordinator. Through a well-communicated implementation of the traffic safety standard in NPRA's own organization, the experts

anticipated amplifications in other enterprises. This will lead to increased knowledge in the road user population about traffic accident causes and traffic safety, possibly implying increased acceptance of traffic regulations (speed limits, signs and traffic marking).



# Validation of the health and work survey (INSAT) under rasch model measurement analysis

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## Abstract

Occupational health and well-being may be understood as a multi-dimensional phenomenon. It comprises the interaction of physical, psychological and social dimensions, which manifests in the workers cognitions, motivations, behaviors, and self-reported physical and psychological health (Molinié & Leroyer; Taris, Van Horn, Schaufeli, & Schreurs 2004; Ilmarinen 2009). The Health and Work Survey (INSAT - Inquérito Saúde e Trabalho) (Barros-Duarte, & Cunha, 2014) was conceived with the contribution of different European questionnaires, and aims to analyze the relations of work conditions and their consequences in worker health and well-being (Barros-Duarte & Cunha). INSAT is a self-applied survey instrument which focuses on several questions related with work situations and their impact on health and well being. It begins with a set of questions designed to collect general and personal information (gender, age, sector of activity, etc.) and followed by queries grouped into seven categories: i) work; ii) conditions and characteristics of work; iii) conditions of life outside work; iv) training and work; v) work and health; vi) my health and my work; vii) my health and my well-being. This survey instrument was developed in 2007 and suffered some changes in 2010 and 2013. The actual survey, the INSAT2013 version, is composed by 154 items (questions). Responses to these items are generally dichotomous (e.g., "yes" or "no", "agree" or "disagree") and/or ordinal (e.g., from 1 to 5, where 1 represents the maximum discomfort and 5 represents the absence of discomfort). To validate the survey instrument it was used the Rasch Model Measurement Analysis. Although the classical statistical methods more used to examine construct validity are exploratory factor analysis (EFA) and Cronbach's alpha, these methods have been criticized by several authors as being insufficient for determining construct validity in psychological survey instruments (Green, Lissitz, & Mulaik, 1977; Cortina 1993; Schmitt 1996; Kline 2000; Waugh, & Chapman 2005; Tabachnick & Fidell, 2007; Sijtsma 2009). The Rasch model is a unidimensional measurement model, which determines that the probability of a person will endorse an item, is related to the difference between the level of the latent construct present in the person and the behavior and attitudes of endorsing the item (Wright, Mead, & Bell, 1980; Apple & Neff 2012). As mentioned by Apple and Neff (2012) "the latent constructs being measured are determined by the probability of questionnaire respondents answering agree or disagree to items of varying degrees of endorsability ranged along the construct" (Apple & Neff 2012). For the validation process of the INSAT survey instrument it was used a sample with 800 Portuguese workers. The sample included six economic sectors: (a) Health and Social Support (hospital front offices and pharmacists); (b) Education (high school and university teachers); (c) Wholesale and Retail (salespeople, store managers and market cashiers); (d) Manufacturing Industry (highly-qualified and technical staff, middle managers, back office workers, warehouse and logistics workers, and assembly line workers); (e) Public administration and defense (directors, middle managers, case-workers, human resources technicians, front and back office workers), and (f) Other service activities (hairdressers, psychologists). The results from the validation process using the Rasch Model Analysis will be presented as well as some considerations and suggestions to promote the survey instrument improvement. References Apple, M. & P. Neff (2012). "Using Rasch Measurement to Validate the Big Five Factor Marker Questionnaire for a Japanese

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# Collective learning process to prevent new accidents in airport construction

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**Keywords:** Prevention of Accidents; Airport building construction; Change Laboratory

## Abstract

A building collapse is one of the worst safety scenarios in civil construction. These accidents involve high costs, and their analyses are traditionally based on methods which are restricted to the immediate causes. Currently there is an increasing adherence to the concepts and methods of systemic accidents analysis. Accidents are understood as events with origins rooted in the system history with an emphasis on strategic choices of technologies, materials, and organization and management of the workforce. This study aims to understand the processes that led to the accidents during an airport terminal construction and help actors to learn and reformulate the activity system of construction to prevent new accidents in the future. For this purpose, a formative intervention inspired by the Change Laboratory (CL) method was conducted. There are five principles that support the CL: cultural mediation theory of human actions, multi-voicedness of activity systems, historicity, central role of contradictions as sources of change and development, and possibility of expansive transformations in activity systems. Ethnographic data were used as mirror data, and were obtained by interviews, observations and document analysis. The CL requires the creation of a collaborative environment and that those who develop activity within the system voluntarily participate. Thus we have an activity system as the unit of analysis. The subject is the consortium and its object is the construction building. Some rules and regulations are given by the government and others internal rules are given by the consortium. Some tools mediate it like schedule, financial resources, materials, executive project, equipment, industrial instruments and meetings. The community is made up of shareholders, concessionaire, local community, stakeholders and government institutions. The division of labor is composed of constructive division, teams division, several departments such as administration, safety, engineering, planning and production. The researchers act as leaders, who is dealt with the task of organizing the collected information in accordance with the theoretical principles and the method concepts, and to support the members of the unit of analysis in their task of preparing systemic diagnosis of the situation and developing a proposal for overcoming the existing problems. To create new solutions, the mirror data supported six sessions along with fifteen participants from different departments. The method stimulates the following learning actions: a) questioning critical aspects of existing knowledge and practices, b) historical analysis of the situation and current empirical analysis explaining the problems, c) designing new solutions d) Testing and applying these solutions. Preliminary results: Many problems concerning the construction site appeared during the CL sessions with emphasis on three severe work accidents and the rise in production and time pressures resulting in work intensification, extra working hours and safety vulnerabilities. The time dimension is something important to be considered in this activity system. A contradiction was found between the rule that limits the time and the complex object which requires planning and a more detailed implementation. Contract rules set by the government defined that the airport should be built within an impractical timeline. The specified period for delivery of work was 24 months. According to participants, this would be the time required just to prepare the detailed executive project. Changes in government regulations of contracts for construction sites and the deadlines led to initiating construction without an executive project under the consortium management, which chose to outsource multiple projects, so that the development of these activities started to take place unsynchronized and in a accelerated rhythms resulting in multiple delays, rework,

improvisations, project changes and adjustments, putting at risk the intrinsic structural safety. Therefore, the appropriate means for building a construction site of this complexity were not available in the prescribed time. The internal operating rules of the consortium also had contradictions with the object, division of labor and tools available. The consortium was formed by different companies with different cultures, tools and rules in place for interacting at the airport construction site. The building itself began to be constructed by employees of different companies working together for the first time under the context of time pressure and without management tools available to facilitate communication and coordination need to create a collaboration required for the complexity of the object. The situation was compounded by a management strategy that focused on the outsourcing of construction activities. Outsourced companies had been contracted hastily and, without the expertise and previous preparation of their own workforce, were unprepared to perform the core tasks of building. Racing against time, accidents and crises had led to further delays, which resulted in four shift of directors, generating more instability that ordered more time for the adjustments. As a result, this vicious cycle of accidents can be seen as predictable abnormalities, which may be far more serious, if it was not for the commitment of professionals who struggled daily to control and adjust the incessant crises and increasing variability. After the analysis of the contradictions of the activity system, the participants recommended as a solution to the bidding process that it should be shortened and should be based on techniques along with pricing. During the construction process there should be weekly meetings with all sectors and inside of each sector; strengthening monitoring; a more wide ranged communication matrix; reduction of bureaucracy; teamwork; specific and continuous training for all areas and improved management of outsourced companies. The CL, as a systematic learning process may help to understand and change the construction activity system. For this process to be efficient it is important that the sessions should be planned to provoke agency from the participants and stakeholders. This study is ongoing and the results presented are preliminary. At the moment an in-depth analysis is being conducted to understand contradictions and the activity system. This construction site had a short period, and many local actions could not be implemented. After the sessions, some meetings have been planned with others institutions in order to discuss the results and implement political actions. The project is supported by Research Foundation of São Paulo State (FAPESP 2012-04721-1), CNPq Foundation and CAPES Foundation.

# Aspects on safety indicators, management and culture in three big companies in Finland

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**Keywords:** accidents; near-misses; safety management; integrated management; suppliers

## Abstract

This paper will deal with accidents, near misses and corresponding incidents, safety management, and safety culture within the case context of three big companies. The case context comprises two big process industry sites of the companies with global operations and units as well. The amount of employees of the both sites rises to thousands. The employees are partly employed directly by the major process industry company, mainly by the often smaller supplying companies. The third company, operating within land transport sector mainly in Finland, employs around 10 000 employees. The two big process industry sites and their supplying network are belonging to the so-called cluster for the HSEQ AP (Health, Safety, Environment, Quality Assessment Procedure) in Finland. Our team is acting as R&D partner within the HSEQ AP Cluster. That is why we do have access to the data describing enablers and performance of the process industry companies and their supplier network. So is the situation with the third case company, too.

Most typically, the suppliers are providing maintenance services to purchasing Cluster companies. Maintenance concerns all technical, administrative and managerial actions to keep or restore production system in a state in which it can perform the required function (c.f., EN 13306). For example, the site <https://osha.europa.eu/en/topics/maintenance> describes demanding and quite risky work activities related to maintenance in various industries:

- Accidents increasingly tend to happen not during normal operation, but rather during repair, maintenance, cleaning, adjusting, etc.
- It is estimated that around 15-20% (depending on country) of all accidents and 10-15% of all fatal accidents are related to maintenance operations.
- Maintenance, repair tuning adjustment is fourth on the list of top 10 working processes accounting for the highest number of fatal accidents over 2003-05 (EUROSTAT-ESAW).
- According to a survey conducted in 2005 in France, maintenance is the most subcontracted function in industry. An analysis of a French work accidents shows that in 2002 maintenance employees were the second most frequent victims of accidents related to subcontracting, just behind construction workers.

The third big case company represents the land transport industry with occupational safety statistics that reflect a relatively high number of accidents in Europe, and in Finland, too. According to the European statistics (EUROSTAT- ESAW), the incidence rate of non-fatal occupational accidents (i.e. cases per 100,000 workers of non-fatal occupational accidents (more than 3 days lost)) decreased in the total working population between 1994 and 2006. This was true for all the three transport subsectors (land transport (road, train and pipelines), water transport and air transport). In 2006, the average incidence rate of fatal accidents was 3.5 in the total working population, while in the land transport sector it was 14.7 (European Agency for Safety and Health at Work). Our own studies have shown land transport by both lorries and trains being characterised by quite high accident rates.

Quantitative data from data bases on HSEQ AP results was compiled from the Cluster of companies in the fields of process industry like steel and forest ones, energy industry, maintenance, technology and system providers, and manufacturing companies. On the other hand, we used safety and other performance HSEQ data that we could get from some purchasing companies. Those companies represented the ones having most long experiences of developing and utilising the HSEQ AP. The corresponding data of supplying companies came mainly from these purchasers' statistics. The lost time injury (LTI) rate was used as a safety performance indicator. We define it here as follows: The LTI rate is defined as the number of one day or more lost-time injuries per one million hours of work.

In addition to injurious incidents (accidents), non-injurious incidents were recorded as well. The latter consisted of real near miss incidents but as well potential hazard conditions and situations observed and reported by employees. This definition of hazard observations is typical to industrial practice in Finland. Partly the empirical section of this study was carried out using qualitative research approach; more specifically, through interviews used to answer the research questions. The interviewees represented the companies operating for the Cluster's purchasing companies, and land transport company.

Our preliminary results show that purchasers themselves are still superior to their suppliers in safety performance. Maybe one explanation to this is the differences in safety cultural heritage and safety management resources. Current very high level of activity in reporting of near miss and hazardous situations maybe explains this superiority of two purchasing HSEQ companies. Safety culture attracts today much attention across industries and sectors. A problem with safety culture is though that no universal agreement on the definition of this concept exists.

The objective of this study is to answer the following research questions (RQs): (1) Is it possible to transfer the key features of safety culture and management from a purchasing company into supplier companies. (2) How the amount of near miss incidents and potential hazard conditions and situations observed and reported by employees effects on the amount of injurious incidents (accidents). Preliminary and limited results dealing with these RQs are based on three case companies that the researchers have been following for many years. The "following" consists of accidents and incident statistics, and data describing the organisation, employees, management, safety climate and culture of the case companies. The latter data have been gathered utilising the interviews mentioned before, but as well by questionnaires.

The findings related to the RQs hopefully will show some tentative relations between safety performance and features and concepts like effectiveness of reporting system, communication of issues "behind" accidents and other incidents, human professional interaction, issues related to safety culture and safety climate, internal responsibility, nontechnical skills, etc. One key ratio, describing the proportion of accidents and hazard observations, might be significant as far as abstract safety culture and climate, and on the other hand concrete proactive notifications of hazards observed.

# Defining and classifying safety interventions

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**Keywords:** safety intervention; Mis-classification; Empirical analysis; Classification system; Evaluation

## Abstract

Background: The scientific evaluation of safety interventions is important in order to find out what works for whom in what conditions. An important element in evaluating groups of interventions is the identification and differentiation of various types of safety interventions. Unfortunately, the safety science literature is not always clear about what a safety intervention is and how different types of safety interventions can be distinguished. Often safety interventions consist of more than one component which may be combined into complex and integrated safety interventions. For example, behavior based interventions could include components of safety training, goal-setting and feedback. Similarly, some structural or engineering solutions require appropriate training as an integral part of the intervention. For example, the installation of patient lifts in a hospital care unit, or the introduction of new safer machinery in a manufacturing plant. If the various components and their contributions to the overall intervention are unclear, then appropriate comparison of results becomes difficult and we risk drawing inaccurate or incomplete conclusions of what works. Aim: We sought to clarify definitions of safety interventions and to provide a classification of safety intervention components. The work was based on empirical analysis of 222 safety intervention studies gathered as part of a systematic review registered in the Campbell Collaboration. The review seeks to identify which safety interventions work - and in what conditions - as a basis for establishing best practices. Method: A systematic approach was established in order to retrieve relevant high quality studies. Search terms for safety intervention studies extended the 'The Cochrane Highly Sensitive Search Strategy for identifying randomized trials in MEDLINE, in order to allow for other study designs, such as non-randomized controlled studies, interrupted time series studies and single case studies. About 40.000 studies were identified from a number of data sources, and after the screening procedure 222 studies remained, covering safety interventions meeting the inclusion criteria. These studies were scrutinized for their definition and types of safety interventions. On the basis of these studies we established a classification system for safety interventions. Results: Six main types of safety interventions were identified, which were safety interventions directed at: • Structural changes: These comprised a number of models and components related to modifications in the physical, organisational or regulatory environment. A common feature of the structural approaches is that environmental factors are changed, often over longer time and perhaps more efficiently. These changes correspond to the higher tiers of the Public Health Hierarchy of Hazard Control (European Framework Directive). One type of structural modification is the engineering control, e.g., introduction of machine safeguards, walkways, elimination of hazardous substances or materials, and other changes in the physical environment, that directly influences individuals' safety without necessarily affecting their behaviour. Another type of structural change is social control, e.g., changes in laws and regulations that may provide coercive power or incentives for people or organisations to change behaviour. • Safety culture approaches: These approaches relates to the modification of social norms, culture and expectations. The most elaborated theory of safety culture is based on Edgar Schein's theory of organizational culture (Schein 2004), where the essence of culture is its core of basic assumptions that manifest as values and in turn defines behavioral norms, e.g., norms that influence safety behavior. Following this, safety culture might be defined as those aspects of the organizational culture which will impact on attitudes and behavior related to increasing or decreasing safety or risk. • Safety Climate approaches: A related concept of culture is climate, which describes the shared perceptions of organizational policies, practices, and procedures, both formal and informal. These, typically leader-based safety interventions,

which impact on safety climate and have consequences for behaviour and safety at work. Since the seminal safety climate article by Zohar in 1980, a number of safety climate studies have emerged, and seems to be supported by a consistent theoretical framework.

- **Behavioural approaches:** Behavioural approaches represent an external focus that explains behaviour in terms of environmental consequences based on behaviourism, where both antecedents and consequences are responsible for affecting the behaviour of an individual. This approach, which can be traced back to B.F. Skinner (1969), has been expanded by inclusion of the mediating role of cognition, and the term organisational behaviour modification has been suggested for this approach. Some commonly used components in behaviour-based safety interventions are safety training, goal-setting and feedback, observation and feedback, verbal feedback, data analysis, and problem solving.
- **Attitudinal approaches:** the focus here is on the modification of knowledge and attitudes and then further downstream by consequences for behaviour and accidents. The theoretical or conceptual support of such approaches is the KAP (Knowledge-Attitudes-Practices) model. Intervention approaches built on social psychology research that has provided theoretical knowledge on the relationship between attitudes and human behaviour.
- **Integrated approaches:** These safety interventions for the prevention of accidents at work are characterised as more complex processes which truly integrate a number of components. Research has emphasised the importance of integrating these various components in order to achieve a high level of safety at work. Each of these groups was further divided into a number of sub-groups. A number of safety interventions that were identified were combined of more components (multifaceted approaches), and formed integrative safety intervention approaches. The study revealed that it is important to consider which elements that form part of a safety intervention component and which does not, e.g., when is safety training forming part of the introduction of new machinery (structural change), and when is safety training a stand-alone component. The study also shows that it is important to distinguish between a safety intervention and its consecutive implementation in a workplace.

**Conclusion:** To avoid misclassification of interventions we propose definitions of safety intervention components, as an independently operating entity in the intervention, which can stand-alone. The paper provides a number of examples based on the retrieved studies on how one might assess what is a safety intervention component and provides suggestions for a classification of safety intervention components.



# A survey of health and safety practices in the Spanish research laboratories studying nanomaterials

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**Keywords:** protective and preventive equipment; safe working practices; training and information; consultation and participation; emerging risk

## Abstract

The extraordinary properties of nanomaterials allow obtaining new materials and improving the performance of the existing ones. Actually, we are possibly facing a new economic and social revolution: the nano-revolution or the sixth economic wave. However, numerous studies suggest that nanomaterials are indeed harmful to health and safety but there is no international consensus regarding it. There is no denying that the exposure to nanomaterials is nowadays one of the most important emerging risks at work and it has to be studied. Nevertheless, workers as the main risk group exposed to nanomaterials, are the aspect least studied by scientists and there is no record of how many workers are exposed to these materials. Moreover, it is remarkable to note that there is no specific regulatory framework for the risk prevention of nanomaterials and that there is very limited information about which preventive measures are being taken. Thus, a complicated picture emerges in the field of nanotechnology regarding occupational risk prevention. For this reason, it is essential to know what these workers are facing and how when talking about this new emerging risk. Therefore, the main objective of this research is to examine the current preventive practices of the Spanish workers exposed to nanomaterials. This exposure occurs mainly in two scales: the industrial one, which includes the production of nanomaterials and its subsequent phases, and the one related to research. In this paper, the authors focus on the working environments devoted to research and development: universities, public research organizations and research and development centers. The main objective of this paper can be divided into the following specific objectives: discovering nanomaterials and their characteristics to which workers are exposed, and proving the relationship between security and exposure to nanomaterials as well as the relationship between health and exposure to nanomaterials at work. Other specific objectives are discovering the information and the prevention training received in order to work with nanomaterials, and checking the consultation and the participation of workers in the planning, organization and implications for health and safety when working with nanotechnology. It is also intended to identify the preventive and protective measures from the exposure to nanomaterials, the good work practices and the personal protective measures for working with nanomaterials. To achieve these objectives, a research methodology consisting of four phases has been followed. In the first phase, it has been conducted a review of the state of knowledge in relation to other similar research that has already been carried out by consulting renowned sources of scientific information. In the second phase, a specific methodology has been established: a quantitative technique (questionnaire) complemented with a qualitative technique (panel of experts). This phase consists of three stages: drafting the questionnaire, having it validated by a panel of experts and obtaining a final questionnaire that will serve as the basis for the collection of necessary data. In the third stage, the election of the sample was made and the questionnaire was sent via email. To obtain the list of names of the individuals to be surveyed, it has been carried out a search through the major networks and technological platforms to identify the agents participating in the current scenario of nanotechnology in Spain. In addition, a detailed exploration of the contents of the web pages of the above-mentioned centers has been performed in order to locate the lines of research and / or development related to nanotechnology. Finally, in the fourth phase, the results of the questionnaire undergo statistical analysis in order to discuss them and to present some final conclusions.

# Dilemmas of building national resilience through organizational security risk management

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**Keywords:** security; terrorism; risk management; regulation regimes

## Abstract

Several scholars have discussed and described two different regulation regimes for regulating risk. Different terminologies have been used to describe these regimes, but Hopkins (2011) refers to these regimes as the “risk-management regime” and the “rule-compliance regime”. A number of scholars have discussed and described advantages and challenges organizations face when applying a risk-management regulation regime in order to make resilient and safe organizations. However, little attention has been paid to the consequences of the application of a risk management regulation regime in the context of building resilience against intentional crimes such as terrorism, although the use of risk management approaches for regulating protection against intentional crimes has increased in multiple sectors during the last decades. Piètre-Cambacédès & Chaudet (2010) call protection from terrorism or other intentional crimes for security, in contrast to safety which implies protection from non-intentional acts. This paper aims to describe and discuss challenges and advantages with applying a risk management regulation regime within the area of security. We identify the different types of challenges an organization faces when governing security risks in contrast to safety risks, by illustrating the different characteristics of safety risks versus security risks. Furthermore, this article discusses the meaning of organizational resilience, and discusses a set of characteristics with organizations that make the application of a security risk management regime challenging. The application of a risk management regime is discussed in light of dilemmas that the Norwegian authorities have encountered when rebuilding the Government complex in Oslo after the bombing by Anders Bering Breivik on July 22 2011, and dilemmas that Norwegian organizations have met after the implementation of new security risk management standards. These examples show that a risk management regulation regime offers no clear guidance for what is an appropriate level of security or any benchmarking for when a company has achieved the “right” level of security. In order to support the companies in their decision-making of whether action are required or not, detailed guidance standards are often offered for how to assess risk and whether or not action is required. We conclude that several aspects with security risks make the application of a risk-management regime challenging from an organizational perspective, both concerning the characteristics of security risks and for the risk analytical tools currently available to organizations. There are some aspects with security risks that make the application of a risk-management regime challenging; Terrorism is a highly uncertain risk and the political aspect of the threat and how to handle it implies that the risk of terrorism is highly ambiguous. Acts of terrorism are obscure, low-frequency events where strategically calculating human beings are the ones who possess the threat. Terrorists can strike suddenly, without warnings and cause enormous damage. Additionally, often the security risk area is just one of several risk areas an organization has to take into account, and most organizations will have the main focus on safety risks. Furthermore, most organizations in Norway lack security competence, benchmarking is difficult because the area is often classified, and little is known about the effect of counterterrorism measures. Moreover, we conclude that the new role of organizations in security management is a new trajectory that places a national security responsibility on organizations, in which they are not necessarily designed and equipped to address.

# Precarious work and safety learning among young Danish employees

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**Keywords:** Precarious work; safety; temporary work; part time work; safety learning

## Abstract

Background: In a Danish and European context there has been an increasing focus on young employees' safety because they have an increased risk of having accidents at work. Young employees are identified as a special area of focus in the Danish Government's working environment strategy towards to 2020. At the same time precarious work is a growing problem and young employees are considered a particularly vulnerable group when it comes to uncertain and volatile working conditions, both at a general societal level and at the workplace level. 'Precarious' work is an ambiguous concept that addresses several forms of uncertainty and vulnerability in the labour market. Precarious work occurs in many different types of employment: Temporary work, project work, work performed by contract workers, part-time work, etc. Also, many highly educated knowledge workers are employed in precarious work. However, there seems to be broad consensus that precarious work is a growing problem, and that it is highly prevalent among the young, unskilled and low-skilled employees. A sign of this is that the extent of part-time work and non-permanent work are increasing in the Nordic countries, and it is largely among young employees. Research shows that there is a clear correlation between uncertain and volatile work and the risk of injuries at work. One of the strategies to target accidents at work among young employees is an increasing focus on safety learning and instruction. However, the international literature shows that safety training has no or limited effect on the prevention of accidents. This is striking compared to the resources used for training in health and safety activities, and striking because knowledge, training, instruction and follow-up, can be seen as a classic and well-established approach to safety learning and prevention of occupational accidents including work injuries among young employees. We assume that learning processes of young people in Denmark does not differ from the conditions referred to in the international literature. However, what we do know is, that many companies have formal learning initiatives for training and instruction of young and new employees in workplace safety. International studies of instruction and training focuses on the dissemination of safety training, and on the effect of this training. The studies typically distinguish between 'on the job training' and 'classroom / school-based training, and they also differentiate between whether it is formal structured safety training programs or more informal 'supervisor / mentorship training'. A distinction is made between the formal learning situations, which often represents a cognitive understanding of learning, and a more informal learning of safety in daily practice representing a bodily and practice-based form of learning. In this paper we examine whether there are differences in the practice of instruction and learning of safety in six different groups of young employees. Aim: The aim of this paper is to examine differences in learning and instruction between various groups of young employees, in order to examine whether young employees in precarious work stands out when it comes to introduction and learning of safety at work.. Method: Young employees in this paper are all employed persons aged 18-24. We interviewed 66 young employees in three sectors, which were the healthcare sector, the metal industry and retail trade. We explored how temporary and part time employees within these three sectors are positioned and position themselves in relation to safety instruction and learning. In a previous study we found that young employees could be categorised into six main groups, which is: Skilled employees, apprentices, sabbatical year students, student workers, school drop outs and temporary employees. We compared differences in patterns of safety learning and instruction in each of these six categories of young workers. Conclusion: We conclude that temporary- and part-time workers have a relatively weaker attachment to their workplace, which also leads to a disconnection to a company's occupational health and safety (OSH) work. In particular these employees were disadvantaged when it comes to the more informal side of safety learning and instruction. Furthermore, in the retail trade young people are often instructed by other young people, and there is a risk that local norms of safety are

established which does not always live up to agreed rules. Young part-time workers, who work 30 hours or less per week, have more than twice the risk of accidents compared to young full-time workers, who work more than 30 hours a week. We also conclude that a large proportion of safety learning within this group of workers is done through informal job training process, where young employees learn about safety through working in practice following and being coached by experienced workers.

## State of play in the OSH field regarding ICT adoption

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**Keywords:** OSH; social media; OiRA; reports

### Abstract

The field of Occupational Safety and Health (OSH) has not traditionally been associated with technological advances. Based on national, European and International legislation, norms, guidance and good practice, OSH is usually conceived as regulating workplace conditions, including facilities and equipment as well as human behavior, more often than not, by setting minimum acceptable standards for both workplaces and employers / employed persons. The enormous advances in Information Communication Technology (ICT) are now having a profound effect on all aspects of OSH, effectively transforming the reach and scope of OSH, in a similar way as ICT is changing other sectors. In the broadest sense, ICT is transforming OSH by helping raise awareness and inform employers / employees and the public at large via the World Wide Web – websites, emails, bulletin boards, online databases (usually accessible by subscription). More recently, through Web 2.0 technologies, such as interactive apps and social media (facebook, tweeter, youtube) OSH has been truly brought into the mainstream, immediately accessible to millions of employers / employees as well as other involved parties (competent authorities, social partners, etc.). The application of ICT to OSH can be further subdivided into open-access and purpose built limited-access ICT systems. As a general rule, closed ICT OSH systems refer to competent OSH authority tools, subscription only OSH databases, university and research centres collecting and processing OSH data. Open ICT systems on OSH comprise websites, free apps, open databases on OSH topics and, by their nature, online social media. As with other fields of economic activity, standardization of OSH data collection remains an issue, especially when attempting to draw meaningful inferences from statistical OSH data being collected. Within the European Union, standardization on OSH data being collected by the member states' competent authorities falls under the framework directive 89/391/EEC and, specifically, the 2007/30/EC (20 June 2007) amendment which obliges member states to prepare practical implementation reports on a 5 year basis. Member states OSH competent authorities, not only need to adopt ICT systems to implement the above directive requirements on OSH, but also need to collect a plethora of other OSH (and in some cases non OSH) data, interface with other ICT systems in the public sector, such as social insurance data and company registers at the same time, be transparent, so that citizens are kept informed of OSH legislation requirements, such as risk assessments, of occupational accidents and diseases and relevant statistics, while at the same time, respecting personal data protection measures. Some competent authorities are utilizing tablets and wireless networks to relay OSH data collection to their servers for safe keeping and further processing. In general, web based solutions are gaining ground, compared to legacy systems, in the quest of competent authorities for efficiency, accuracy and data sharing. An example of an ICT OSH tool, which is both open source and freely available to interested employers, is the Online Interactive Risk Assessment tool, popularly known as OiRA. This has been developed by the European Agency for Safety and Health at Work and is being customized by various member states' competent authorities for a selected number of sectors of economic activity. It is an excellent example of win-win use of ICT in OSH benefitting both the regulator (state labour inspectorates) and the employer (implementing a meaningful risk assessment to safeguard OSH levels in the enterprise) in a quick and interactive way. Going forward, the need for further development of ICT tools such as OiRA, of mutual benefit to all concerned parties is evident. Online apps which can comprehensively combine the national regulators' requirements with the real OSH needs of businesses, delivered in an easy to adopt format, while utilizing the latest online social media capabilities, will truly transform the OSH field.

# Building competence of future ohs professionals in risk management at the faculty of safety engineering VSB-TUO

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**Keywords:** OHS professional; tertiary education; risk management; competency

## Abstract

Occupational health and safety (OHS) is a wide interdisciplinary field which aims to ensure that a man at a workplace is efficiently protected from various hazards associated with technologies and processes in place, performed tasks, working environment and interpersonal relationships as well. Former technician approach, focused on technology/machinery/equipment safety, has been replaced by system approach built on risk assessment and management with high emphasis on human factor. Ensuring OHS often requires a cooperation of many different OHS specialists (safety technician, industrial hygienists, occupational physician, physiotherapists, etc.) and experts from other disciplines (e.g. fire protection, environmental protection, product safety, security, insurance). The coordination and management of OHS should be covered by an OHS professional, who is cooperating with the individual experts. The OHS professional should have a deep understanding of occupational risk assessment and management plus sufficient knowledge and skills in all the above mentioned specialized fields across natural, technical and social sciences to be able to communicate with different experts and to recognize the need of their involvement. Multidisciplinary character makes OHS discipline very comprehensive and demanding. Education and training of OHS professionals presents therefore a challenging task. Questions regarding their preparation for a future career and the following lifelong learning are among key topics for professional discussion and are reflected in OHS national/international policy. Currently, there are no unified legal requirements on OHS professional competence at international, nor EU level. The International Network of Safety and Health Practitioner Organisations (INSHPO) recently published a framework for practice, role, knowledge and skills of the OHS professional. Two voluntary certification standards in the field of OHS were defined by the European Network of Safety and Health Professional Organisations (ENSHPO) - European Occupational Safety and Health Manager (EurOSHM) and European Occupational Safety and Health Technician (EurOSHT). ENSHPO requirements are incorporated into the National Register of Qualifications and the National Register of Occupations in the Czech Republic (CR). Moreover, CR set legal requirements on professional competency in the field of OHS – the Professionally competent person performing tasks concerning risk prevention and the Coordinator for safety and health matters on the construction site (see Act no. 309/2006 Coll.). Faculty of Safety Engineering VSB - Technical University of Ostrava (the faculty) responds to the growing demand of practice for highly educated professionals in the area of OHS. The faculty is still the only faculty of its kind in the CR providing multidisciplinary study fields covering industrial safety, fire protection and civil protection. Within the fields of studies “Occupational and Process Safety” and “Safety Engineering”, it prepares specialists for the occupation in the area of OHS. The SWOT analysis and the feedback from the workshop on education of OHS professionals (organized by the faculty at the 15th annual international conference on OCCUPATIONAL SAFETY AND HEALTH 2015, 13th-14th May 2015, hotel RELAX\*\*\* Rožnov pod Radhoštěm Czech Republic) have shown some important weaknesses in current educational approach. Building of practical skills in risk assessment and risk management present a main challenge. Currently, this competence is developing using three main tools: short practical trainings at workplaces (5 weeks within bachelor’s study and 2 weeks within master’s study), educational excursions (regularly every term), and bachelor and master theses on practical topics raised by companies. These tools proved to be very useful, however, they are still not sufficient for gaining necessary experience. Therefore, other opportunities for cooperation with industry are looking for. Action “Red Scorpions” based at ArcelorMittal Ostrava (metallurgical company) is one of the great successes. Students of the faculty perform special supervision on construction sites to prevent

occupational accidents. The main activity consists of a permanent presence on the site, safety inspection and immediate intervention. Currently, 15 students are involved in this action. Significant strengthening of the partnership among the faculty, industry and research has been achieved through the project "Safety AGENT" (CZ.1.07 / 2 April 00 / 31.0049), which was implemented by the Czech Technology Platform on Industrial Safety (CZ-TPIS) and the faculty in the period April 2012 - April 2014. Many training activities (i.e. internships, courses, seminars, round tables) focused on various OHS topics were organized within the project. Higher Education Development Fund of the CR facilitates educational innovations. Interactive course on occupational risk assessment was organized in cooperation with Edwards, Ltd. and Kirschstein & Partner (Higher Education Development Fund No. 173/2015). The aim of this paper is to introduce the system of education of future OHS professionals at the faculty in the context of legal and other requirements at EU and national level. Current challenges in university-level education of these experts are discussed. The great emphasis is placed on developing practical skills in the field of occupational risk assessment and management, as this is considered the key competence of OHS professionals. Close cooperation with industry and active OHS professionals is essential in order to develop the practical skills in this domain.

# Lifestyle, psychosocial and physical working conditions as determinants of work ability

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**Keywords:** lifestyle; older workers; work ability

## Abstract

**Introduction:** Individual decisions of continuing work activity largely depend on the subjectively perceived work ability/inability. According to data from the European Research Working Conditions conducted in 2010, only 61% of Polish older workers will be able to continue the current job at the age of 60 years (EWCS 2010). Healthy lifestyles, in particular: a regular physical activity, a healthy diet, nonsmoking, reasonable use of drugs or limited alcohol consumption can efficiently prevent the development of many diseases, increase the years and good quality of life (WHO 2002). In the existing research on work ability/disability of older workers some occupational and non-occupational determinants have been identified, such as: age, education, physical activity, healthy diet, working environment, type of work and occupational stress (Tuomi et al., 1998). The aim of the study was the impact assessment of individual lifestyle elements and psychosocial and physical work demands on work ability of the older workers. **Material and methods:** The study covered 1067 older workers. Their lifestyle was surveyed with the use of a questionnaire developed within the study. The survey also included questions concerning the general information such as: gender; age; education level; marital status; information on having children, and the number of children had; the size of the enterprise in which an employee works; the position held; total length of service; length of service in the current position; and anthropometric data such as height, weight and the BMI. Psychosocial and physical working conditions were assessed by the Karasek Questionnaire. Work ability was assessed by the Work Ability Index (WAI). The study involved employees in the following 5 sectors: construction, trade, health care, government and social assistance. **Results and conclusions:** Men accounted for 56% of the entire group. The mean age of the subjects of the study was 54.8 years (SD = 3.95). Most of the workers were married and educated at a secondary level. Most workers (46%) were overweight (BMI 25-29.99). For approx. 39% of the subjects of the study, the BMI value range was normal (18.5-24.99). Older workers in Poland presented low physical activity, 32% of them smoked cigarettes, 49% consumed alcohol and most of them ate fruits and vegetables too rarely. Their work ability appeared to be good (44.4%) and moderate (36.4%). White-collar workers had significantly more often excellent work ability compared to blue-collar workers ( $p \leq 0.05$ ). The highest percentage of people with poor work ability was observed among construction workers. Analysis of the results indicates that occupational stress among older workers was higher than the Polish general population, due to the smaller range of control, a higher level of job insecurity and psychological stressors, less support from colleagues and increased physical strain (Żołnierczyk-Zreda, in press). In order to maintain work ability of the older workers it is necessary to limit psychosocial and physical requirements, in particular job insecurity, psychological stressors, and heavy physical exertion. An analysis of the results obtained indicates the occurrence of statistically significant relationship between work ability and the individual elements of lifestyle, in particular health condition, a diet rich in cholesterol, smoking and physical activity.



# Building information modeling as a safety tool: a review

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**Keywords:** Building Information Modeling; Safety; Review

## Abstract

Occupational health and safety (OHS) in building construction remains a worldwide problem considering workplace injury, illness and fatality statistics. In the building construction sector, safety planning is carried out separately from the design and planning phases of the project. Safe construction requires care and planning throughout the project life-cycle, from design to maintenance. Initial approaches for improving OHS consider the safety aspects in the design phase and the development of manual safety processes in the execution phase. Building Information Modeling (BIM) is a digital representation of physical and functional characteristics of a facility that provides a framework for collaboration, a multi-disciplinary environment that brings together all the parties of the Architecture/ Engineering/Construction (AEC) industries. The application of BIM is currently increasing rapidly in construction operations planning and management and also in safety management. BIM has been rapidly recognized to change the process how construction projects are delivered. It has also been realized that BIM can be utilized to promote safety management, and combine safety with other construction planning processes. Moreover, the growing implementation of BIM in the AEC and Facilities Management (FM) industry is expected to change the way safety can be addressed as can be seen in the literature review by the large number of contributions in recent years. Occupational health and safety management is a multi-dimensional field. The nature of its research, development and their results has a heterogeneous nature with links to the basic sciences such as psychology and medicine, and, besides of that it has strong links to the applied sciences such as education, engineering and management. This can result in solutions that can be characterised as engineering controls and health management system as part of business decision making. The overall interest around BIM and its applications have created wide variety of attempts some of which have also addressed occupational safety issues. Recent advancements of BIM technologies are providing decent starting points for the development of solutions for pro-active site safety planning and management. This means that the user is not just a passive observer of potential problems but he/she has all necessary functions available as efficient solutions enablers for improving the working conditions. Compared with the earlier research we consider that the selected research approach having collaborative safety planning and safety awareness building as starting points can result in novel contributions by combining safety management functions with appropriate BIM solutions. Construction sites are dynamic and on-site situations are changing in terms of permanent and temporary structures. Therefore, information of the construction site should be updated based on the project progress monitoring, and the prevention measures for safety should be used to give more awareness to workers. This information can be reflected using (BIM). One of the major obstacles to effective safety planning is that traditional safety planning still largely relies on paper-based 2D drawings and schedules to understand the needs for safety equipment on a construction site. In fact, no practical approaches exist to date on how the data can be used by practitioners in the industry applying BIM. Hence, it is important to investigate more advanced methods to integrate this information. The present research aims to review the evolution of the research in BIM and its relationships between construction safety with the aim of fostering and directing further research prevention programs for safety and in real-time safety management.

# The evaluation of psychosocial risks: between the frameworks of diagnosis and prevention

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**Keywords:** Employment and working conditions; Psychosocial risks; Risk assessment; Diagnosis vs intervention; Primary prevention

## Abstract

Psychosocial risks, its diagnosis and better understanding, have, in recent years, occupied a central place in the societal debates, setting new demanding to the ones involved in the field of occupational safety and health, namely in the intervention related to the prevention of occupational accidents and diseases. Apparently, the sub-categorization of these work-related risks as of "psychosocial" nature seems to justify the fact that psychologists are increasingly called upon to respond to such requests. These requests often reflect an expectation that the intervention will contribute to help workers, victims of such risks, to take ownership of other strategies, suitable of allowing them to react more positively to the "work demands". Therefore, in this type of interventions, potentially "psychologizing", to which we critically position ourselves, an intervention at the individual behaviour level is favoured, leaving aside the collective difficulties (Loriol, 2005). It is the concrete work activity and the options on work organization that should assume the centrality in the analysis of these risks - which, actually, interact with other risks, making them, in the majority of the cases, more worrisome. Indeed, it is no coincidence that the visibility given to psychosocial risks arises in an historical context marked by the intensification of work rhythms and by a certain naturalization of physical and emotional exhaustion (closely associated with increasingly precarious labour relations), together with a professional activity whose complexity has also increased significantly. The concerns of evaluation and diagnosis of psychosocial risk factors boosted the development of several questionnaires, their widespread dissemination, and even their "exportation", not always sensitive to the specificities of local realities. Beyond the issue of "diagnosis", the purpose of this communication is to discuss the type of prevention practices that have been privileged in this area, particularly questioning the limits of a type of usage of statistics and individual approaches. But also to bring to the debate the difficulties inherent to the construction of prevention by the actors of safety and health at work: quantifying risks is a means of giving them visibility and therefore legitimize an opportunity to prevent work accidents and occupational diseases? In which form can the work organization constraints be expressed in its specificity, in a quantitative way? The answer to these questions will be articulated on the comparison of some reference instruments in this area and the theoretical and epistemological approaches that underlie them: (i) the Copenhagen Psychosocial Questionnaire (COPSOQ), available in more than 25 languages, and used as a support to comparative studies among various countries in Europe and abroad; (ii) the classification developed by the College d'Expertise Suivi des Risques Psychosociaux au Travail (French expert group on psychosocial Risks at Work) (Gollac & Bodier, 2011), including a number of indicators of psychosocial risks, grouped into six dimensions, and used as a frame classification of these risks by the European Working Conditions Survey (EWCS); and (iii) the Health and Safety Survey (INSAT), developed in Portugal (Barros-Duarte, Cunha & Lacomblez, 2007; 2010; 2013), but widely used abroad, particularly in Brazil and Angola. Prevention, its objectives and its means of action, will feature the analysis that we will develop, but not without equating, at the same time, some alternatives. These possible "alternatives" consist in giving visibility to the suffering at work, through: an analysis of what constitutes the complaint, but still paying attention to what is known to be hidden, to what deliberately is not declared, as a "defensive strategy" - out of fear of having their own job threatened; and returning the data obtained with key players in the transformation of working conditions, in order to rethink the work organization.

# Investigation of occupational accidents and prevention: analysis of the practices of labour inspectors in Brazil

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**Keywords:** analysis of occupational accidents; chain model; Labour Inspector; accident prevention

## Abstract

One of the tasks of the Labour Inspectors of the Ministry of Labour and Employment (MLE) of Brazil is to investigate and to analyze the causes of occupational accidents as well as the working conditions with the potential to generate such events. The analysis of an occupational accident can't end with the presentation of a report. It is necessary to seek the dissemination of the lessons learned from the analyzed event, and also to verify later the compliance with the preventive measures recommended in the report in order to avoid the recurrences. This paper describes a case study limited to the accidents occurred in the metal industry and analyzed by the Labour Inspectors from the Regional Agency of MLE in the State of Minas Gerais, from 2011 to 2012. The study aimed to analyze the contribution of the carried out accident's investigations to prevent similar events. The main sources of information were the accident analysis reports prepared by inspectors, database of the Federal System of Labour Inspection (computerized system of inspection reports of MLE), and semi-structured interviews with eleven Inspectors. The results were presented and discussed with reference to the "chain model", developed by Lindbergh and Hansson (2006) to evaluate the effectiveness of workplace accident investigations produced by inspectors of the Swedish Work Environment Authority. This model consists of five links: notification, selection, investigation, dissemination and prevention. The focus was on the analysis of the findings and their implications with regard to two links: dissemination of knowledge and prevention of further accidents. The dissemination of the knowledge gained from learned lessons during the analysis has not occurred between the inspectors, much less outside the MLE. To some extent, the information exchange takes place informally between the Inspectors. There are not formal meetings, conferences or seminars where inspectors can share the lessons learned from the investigated accidents. The employers don't receive the reports of accident analysis and the labour unions, organizations that denounce more accidents to the MLE, usually don't receive this information. Moreover, the MLE does not make available database on occupational accidents analysis on the Internet for consultation by interested social actors such as business owners, safety engineers, occupational physicians, teachers, lawyers and public prosecutors. Prevention as a consequence of the monitoring of measures to be adopted by companies rarely occurs. The annual planning of the MLE does not include return inspections to follow up the implementation of the measures to prevent the recurrence of these unwanted events. The Inspectors pointed out several factors that block these actions, such as the low number of Inspectors and the work goals imposed by the MLE for other purposes. There is also no systematic partnership with labour unions or other organizations to monitor the safety at workplaces. In short, from the perspective of the "chain model", it can be said that there's little effective contribution of the investigations of occupational accidents that are carried out by Labour Inspection for preventing similar events. Therefore, it is necessary to the MLE takes actions to strengthen the dissemination and prevention links of the "chain model".

# Work-based learning: an evaluation of the learning opportunities available for the development of OSH professionals within their workplaces

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**Keywords:** Work-based learning; OSH professionals; competencies; professional development; capabilities

## Abstract

In recent years, there has been an increasing amount of literature produced on the competencies required by today's OSH professionals. Much of the research has sought to identify the key competencies or capabilities of professionals within a range of working environments, from practitioner to director. Several researchers have warned of the consequences of developing rigid frameworks that cannot adapt to a rapidly changing world of work or be sensitive to local cultural issues. University courses can look at professional bodies, such as IOSH, the requirements of regulations and standards and frameworks developed by voluntary organisations such as INSHPO when determining their learning outcomes, however, how much control should the OSH professional have on their learning and what opportunities are available to them to carry out such learning within their work environments? Work-based learning (WBL) can provide OSH professionals looking at enhancing their professional development with the opportunity to take control of their learning and to design their degree to their own requirements. Norman and Jerrard (2012) carried out a 5 year longitudinal study to evidence the level and quality of acquisition of key design management skills by students undertaking a MSc degree in Design Management using WBL contracts. They identified that WBL at postgraduate level 'helped bridge the gap between skills and knowledge found in the University and the Workplace.' This paper builds on the research carried out by Norman and Jerrard, by considering the learning opportunities available to students to not only acquire key health and safety management skills, but other transferable skills identified for their own professional development. The aim to identify potential barriers to learning and professional development within the workplace. Research was based on a sample of 45 learning contracts, WBL projects and associated reflective reports submitted to the Learning at Work department of the University of Portsmouth as part of an MSc Occupational Health and Safety Management over the past 5 years. General and project specific learning outcomes were categorised based on the following prescribed levels of work-based competencies (University of Portsmouth 2014):

- Demonstrate mastery of a broad personal or formal knowledge base relating to work;
- Consider issues beyond the immediate area of practice, and take a critical approach to the thinking and assumptions that are being used;
- Develop and evaluate concepts, theories and models that apply to work;
- Manage dilemmas and value-conflicts and find ways forward in problematic situations;
- Show through your projects the application of new ideas and theories;
- Develop innovative responses in complex and unpredictable situations;
- Design and make use of methodologically sound research that contributes to your work and your organization's business.
- Critically review your courses of action;

this includes reflecting on the impact of your work in a wider context. Results of a literature review focussing on WBL, professional development and OSH professional competency will be summarised, before presenting a qualitative analysis of past Masters students learning contracts and WBL projects. Initial results show a variety in the learning opportunities made available by employers, although a common trend in the general learning outcomes sought by students. Common barriers to acquiring the required skills include the market led nature of the workplace, lack of support for professional development by the employer or direct line manager and the nature of the students employment contract. References: Norman, c. and Jerrard, R.N. (2012), 'Design management education and work-based learning', *Art, Design and Communication in Higher Education* 11:2, pp. 155-166, University of Portsmouth. (2014). V6: Learning Management Handbook. Portsmouth: Author

# Zero harm: reality or myth for workers?

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**Keywords:** Zero Harm; Workplace injury; Accident reporting

## Abstract

**Background and Aims:** Over the last decade, Australian industry has overwhelmingly embraced the concept of Zero Harm as a mantra for espousing their commitment to safety, a workplace free from injury or harm. The underlying principle of Zero Tolerance is that certain actions will not be tolerated under any circumstance. Zero harm is similar in some aspects to zero tolerance, in that within a workplace, the concept of zero harm is creating an injury and incident free work environment where injuries are not acceptable and everything possible is undertaken to prevent them. Zero harm can also have many other derivatives including goal zero, the target is zero and vision zero. Whilst this is an admirable goal, what does Zero Harm mean for employees, is it achievable and does it influence workplace behaviour? What is known is that government and industry have acknowledged that Australia's current safety performance is not acceptable or sustainable. With a cost of over \$60 billion representing 4.8% of Australia's GDP, every year approximately 260 workers die and over 680,000 suffer some form of workplace injury or illness. To address this, workplace safety legislation continues to evolve to provide governance for improved safety, and organisations have invested millions into Zero Harm initiatives including the use of behavioural safety programs and measuring safety performance against lagging and leading indicators. Zero Harm proponents postulate that there can be no other goal other than zero harm, yet opponents argue that zero harm ideology is detrimental to improved safety performance through organisations setting goals that are unachievable, unbelievable and driving a culture of under reporting of incidents to achieve set key performance indicators. As a result, the aim of this research was to undertake a quantitative examination through surveys with employees of a large global oil and gas company to determine the group's perceptions of zero harm, including its' effectiveness and how the concept can be manifested and measured in the work environment. **Method:** 300 employees (150 from Australia and 150 off-shore workers) completed a battery of questionnaires that focused on obtaining perceptions regarding: (a) why there is a focus on Zero Harm, (b) who should promote the Zero Harm concept, (c) what is the meaning of Zero Harm and how should it be measured, (d) whether the concept is achievable and relevant, and (e) the perceived impact of Zero Harm on the frequency and reporting of workplace incidents. **Results:** Analyses revealed that the largest proportion of employees believed that the aim of Zero Harm was to reduce injuries at worksites, followed by a belief that the company did not want to be prosecuted. A range of sectors were believed responsible for promoting the Zero Harm concept, including: workers, senior management, legislators and the union. The majority of participants believed that the concept was most related to "No harm to anyone, anytime while at work." However, a level of uncertainty was identified in participants' beliefs regarding whether the concept was achievable ( $M = 3.2$  measured on a five point scale) with younger workers being statistically less likely to believe the goal was achievable. Despite this, participants reported a high level of consensus regarding the value of "making every effort to maintain and improve safety" although some believed this could result in under reporting of incidents. Multivariate analysis revealed that being older and reporting a perception that the company regularly promotes safety initiatives were predictive of views espousing Zero Harm. There were no between group differences between Australian and off-shore participant views. **Conclusion:** Taken together, employees believed in the value of the Zero Harm concept but questioned whether the target was achievable. This paper will further outline the key findings in regards to practice to improve workplace safety performance as well as provide direction for future research.

# Computer-aided advanced technique for the analysis of occupational accidents

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**Keywords:** computer-aided model tool causes top event; computer aided; top events; root causes

## Abstract

Even if since many years a remarkable effort has been implemented in Italy to reduce the number of occupational fatalities, the same is still impressive, at least in terms of frequency rate; moreover, the recent crisis and large-scale job reductions made the data analysis somehow more complex. Stated that Risk Management is the final goal of Occupational Risk Analysis, the available national databases are a precious instrument for prevention. Still, some common misuses of the statistical data can lead to biased forecasting of expectable accident rates, and they consequently produce important distortions in the prevention action. This is commonly due to one or more of the following causes: 1 – reduced statistical basis (at regional scale, without consideration of the local industrial situation), 2 – poor analysis of boundary data (e.g. Economic and occupational situation), 3 – wrong range of time for the aggregation of the accident data, causing overestimation of catastrophic exceptional events. Some databases (e.g. US DOL OSHA) importantly evolved from the traditional approach (based on the Heinrich model), to new models including information on the violations of the safety standards, which play a pivotal role for an exhaustive Risk Assessment (in absence of this datum only Attention Index can be inferred). In any case, a quite useful input for an effective occupational risk prevention is an unbiased knowledge of the embedded causes of the work-related accidents. Such causes (namely Root Causes) lay at the very base of the events chain leading to the accident: a limited comprehension of Root Causes can involve slapdash remedies, occasional audits and inspections clearly inadequate to highlight and control the criticalities of complex activities. Since some years a research team working at Politecnico di Torino, Department of Environment, Land and Infrastructure Engineering, developed, on the basis of an extensive investigation on the different approaches to the work-related accident analysis, the original CCCP (Computer-aided Cause Consequence for Prevention) technique. CCCP was specifically conceived for the in-depth examination of single accidents and is not affected by the problems of data availability and quality, even if the national/foreign statistical data are still an eligible reference. Moreover, a two-way approach makes possible to analyze both the specific occurred accident, and to verify the expectable effectiveness of preventive measures in a large number of situations. The integrate software environment Infortuni sul lavoro (Work related accidents) - Root Causes translates the theoretical model into a useful computer guide. All the occurrences are strictly codified with the aim of making the analysis objective and free from ambiguity. Cccp leads to focus on the intermediate and root causes of work-related accidents minimizing the influence of subjective judgment or hasty evaluations, and the too easily reached conclusion of incorrect behavior of the victim. The research group has been testing CCCP on a number of case histories of fatal accidents in different ATECO sectors analyzed within the framework of Prosecutor Investigation gaining real interesting results, in an analysis environment complete, user friendly and, thanks to its system approach, immune from errors due to subjective judgments or hasty evaluations. Some case histories on occurred fatal accidents will be provided and discussed in the presentation. The research work is funded by INAIL (the National Institute for Insurance against Accidents at Work), within the project “Centre for Studies on Safety Culture and Prevention” established in 2011. Camisassi A., Cigna C., Patrucco M., 2004, Safety at the construction sites: risk analysis and operating conditions of the machineries and lifting equipment (in Italian), GEAM - Geingegneria ambientale e mineraria, XLI, 19-32. Demichela M., Palamara F., 2007, Occupational accidents risk analysis using clustering algorithms, Proceeding of the European Safety and Reliability Conference 2007, 25-27 June 2007, Stavanger, Norway, 1261-1265. Demichela M., Murè S., Piccinini N., 2006, Assessment

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# Occupational risk assessment and management at the highway maintenance yards: suggestions drawn from some experience in Italy

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## Abstract

The Italian Highway System covers more than 6000 km, and it is constantly growing. A large number of km can be considered critical with reference to the need of important maintenance interventions. In such operations, a series of internal and external parameters increase the typical problems of the common highway maintenance yards, such as limited spaces, hurry to complete the work, etc.. This, in addition to some misconduct of the users of the highways, leads to a significant number of accidents, often characterized by high Severity Rates. A research Teamwork operating in the field of OS&H in Politecnico di Torino started a research on the topic to accomplish a request from the prosecutor office. The study was based on rigorous schematizations, introduced to categorize thoroughly the various contexts, scenarios and types of maintenance and improvement highway yards. At the purpose, the Authors improved and integrated the basic classifications below offered for initial reference: • "external" parameters: 1. orographic characteristics, geomorphological, etc. 2. weather 3. others (eg interventions in tunnels, viaducts, ...) • "internal" parameters boundary 1. traffic loads in general and heavy traffic and related changes "seasonal" 2. constraints for specific interventions and interference in the case of processing carried out simultaneously 3. other (eg supply management, emergencies, ...) • type and characteristics of the site 1. stationary yards / mobile sites 2. systematic / occasional 3. characterized by urgency / and sites of longer duration 4. interventions not involving operations of conservative maintenance / ameliorative ... • other The main aspects covered are summarized in the following points: • carry out an extended survey of the accident data recorded in the official Italian databases, and some in deep analysis of special cases, using an original computer assisted technique recently set up by the Authors; • Discuss - on the basis of a number of direct inspections, and of the analysis of the available safety plans and documents - the typical characteristics of the Italian highways maintenance yards in order to define a categorization which in future can be used as a systematic reference coherently with local situations and typical accident rates; • make available an efficient, affordable and well tested approach for the safety inspections of the highway maintenance yards. The results can be stored in a specially engineered database which directly computes a quality coefficient for each situation in the various site categories. The database is integrated with descriptive fields in which information can be entered on the techniques, technologies and specific organizations: it can therefore disseminate new solutions and good practices; • make available, on the basis of both direct experience and information drawn from technical references, a number of well tested prevention proposals based on the technical improvements made possible by the introduction of new techniques and technologies, and on procedures defined with greater specificity and details. In the paper the authors discuss the main achieved results and some possible future developments of the research work



# What we talk about when we talk about HSE culture

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**Keywords:** HSE culture; Literature study; function of HSE culture

## Abstract

This paper is an extensive review of 235 journal papers addressing HSE culture issued between 1992 until 2014. The review was conducted in order to analyze the historical development of the concept of HSE culture. This paper is focusing on the spread of the term “HSE culture” and its belonging meaning within the community of safety research. The work is related to our previous work regarding the use of the concept of “culture” (Bye, Rosness & Røyrvik 2015). The review of the journal papers has been supported by a statistical analysis of data obtained by a structured and systematical registration of information from the 235 journal articles, by using a structured code book developed in order to address the following research questions: 1. What does “HSE culture” signify? 2. Have the number of publication addressing HSE culture changed over time? 3. Have the definition of HSE culture changed over time? 4. Is there any correspondence between the profession of the writers and the definition/use of HSE culture? 5. Is there any correspondence between the branch of industry addressed and the definition/use of HSE culture? 6. Is there any correspondence between branch of industries and the year of publication? 7. Is there any correspondence between the nationality of the writers and the definition/use of HSE culture? 8. Which methods have been used in studying “HSE culture”? 9. What is the extent of empirical studies on “HSE culture”? The coding of the journal articles was conducted by a team of researchers. A test coding was performed in order to ensure consistent in coding and as high accuracy as possible, between different researchers. The reliability of the data regarding variables i.e. name of authors, year of publication, journal, author discipline, nationality of the authors, number of references in google scholar, branch of industries, region of the world, methods applied and the formal definition of “culture” are considered as high. The reliability of the data related to the variables regarding the meaning of the term “HSE culture” is weaker due to the impact of degree of accuracy between different researchers. The analysis has been twofold. Firstly, we have analysed the spread of the term “HSE culture”. Then we have looked at the variation in what the term signifies, i.e. how the term are defined and used in the documents. The methods used in the statistical analysis has been frequency, table and correspondence analysis. The use of correspondence analysis makes it possible to “correlate” categorical data. The result of the statistical analysis were the interpreted. In the interpretation, we have applied a semiotic perspective, focusing on the distinction between signs (form) and the signified (meaning). Among our finding is that there is a correspondence between the profession of the writers and how “culture” is defined and/or used in the texts. Psychologist and engineers tend to treat culture as one factor among others which influence human behaviour, whereas anthropologist tends to use culture as a metaphor to signify the holism of an organisation. More than 70 % of the articles using the term “HSE culture” are only addressing safety. Further, almost 30 % of the articles are reviews of other articles, and 23 % of the papers use survey data. Almost the half of the most cited papers (more than 100 citations) are reviews of other papers. The study is a part of the research project Translating HSE Culture in the petroleum industry (TRACULT) which is designed to generate knowledge on how regulatory authorities and companies have used the concept of HSE culture in order to improve safety in the petroleum industry in Norway. Bye, Rolf Johan, Ragnar Rosness, and Jens Olgard Dalseth Røyrvik. "‘Culture’ as a tool and stumbling block for learning: The function of ‘culture’ in communications from regulatory authorities in the Norwegian petroleum sector." *Safety Science* (2015).

# Professional competence, air and seamanship

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**Keywords:** Professional competence; Seamanship; Regulation regimes

## Abstract

In the NRC project PROCOM, we discuss core changes in transport professions, specifically related to how competence are viewed, challenged and changed by current managerial and regulative trends and regimes. For transporters, standardized rules have a central part in the day-to-day activities. Safety management systems implies in many cases detailed prescriptions on how the work should be performed, e.g. in the form of standardized operating procedures (SOPs), checklists etc. Technological developments have also led to an increasing automatization of work tasks that previously involved special considerations. How activities and processes shall be carried out is to a large degree defined by procedures and legal rules. In this paper we discuss how types of rules are used in different types of transport branches with rather different degree of task complexity and dependency on skill-, rule- and knowledge-based performance. Further, we will discuss how procedures and technology affect the skills of professions. Different discourses exist on the topic of the effect standardization and technological development has on skills; while some claims it will erode the skills of the actors, other focus on how new framework conditions alter and create new forms of skills. Lending inspiration from both these discourses, we will discuss how the effect of standardization and technological developments 1) redefines that profession and 2) how this changes the vulnerability in critical situations. By comparing four cases, two from the maritime sector and two from the aviation sector, we elaborate on how to understand the importance of professional competence, changes within the different sectors, global currents related to issues of standardization and proceduralisation, actor strategies for handling different regimes and finally how these issues relate to safety. Tim Ingold discuss the artisan production as fundamentally different than technological production, and writes that “the artisan was gradually supplanted by that of the operative whose job it is to set in motion an exterior system of productive forces, according to principles of mechanical functioning that are entirely indifferent to particular human aptitudes and sensibilities. (Ingold 2000.: 295)”. In line with this we argue that degree of skill, autonomy and task complexity– is important for how actors view their competence and identity related to that profession. Furthermore, Ingold writes that the technological evolution involves an increasing externalization: “Indeed the burden of Marx’s argument is that history has involved a progressive objectification and externalisation of the productive forces, reaching its apotheosis in the industrial automaton. As the outcome of this process, machines have not so much made as been made by history, one which human beings, to an ever increasing extent, have become authors of their own dehumanisation.”. In this article we compare the professions by the dimensions of 1) task complexity and 2) extent of rules governing work practice. The two dimensions are very much related to each other and could in many instances be interchangeable descriptions of identical conditions. Nonetheless, empirically we find that this is not so, as regimes differ in how rules, procedures and technology is viewed and control is maintained; thus influence how tasks are allowed to be performed.

# A model of “breakthrough change” in workplace OHS performance: results of an exploratory multiple case study

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**Keywords:** OHS performance; organizational change; organizational learning

## Abstract

**Introduction:** Research has provided much information about the determinants of organizational performance in occupational health and safety (OHS) at a given point in time (e.g. OHS management, leadership in OHS, employee participation in OHS, safety culture and safety climate). Much less is known about determinants of improvement in OHS performance. We would expect the two sets of determinants to overlap, but not necessarily be the same. The OHS literature has a sparse theoretical base regarding workplace improvement in OHS performance. This study aims to address that weakness by understanding the commonalities among cases making especially large improvement in OHS performance within a population; i.e. “breakthrough change” (BTC) cases. **Data collection and analysis:** The workers’ compensation administrative database for Ontario, 1998-2008, was screened to find the firms that had moved during this period from being among the 50% with the highest workers’ compensation claim rates to being among the 20% with the lowest claim rates, within their respective industrial sector. All were recruited to a brief interview and four were purposefully selected for in-depth case study, including a manufacturer of metal products, a manufacturer of plastics, a food retailer, and a social agency that operates group homes and provides community services. Qualitative data were collected in 2010-11 through 33 semi-structured interviews, observations during a two-day worksite visit, and review of documentation. Administrative data from the enforcement and insurance authorities were also used. Within-case and cross-case analysis was conducted using several data reduction and synthesis techniques. Ultimately, for each case, several case-specific BTC “factors” (themes) were identified. A factor was defined as an aspect of the context, process and content of the BTC that (potentially) contributed to its occurrence. The cross-case analysis sought to derive more general cross-case factors from the case-specific factors. In a final step of synthesis, a 12-element conceptual model was created from the 11 cross-case factors, plus the final outcome of decreased injury and illness. **Results:** According to the model, four elements are necessary for the initiation of BTC (external influence, organizational motivation, knowledge transformation leader (KTL) and new OHS knowledge) and three elements constitute the outcome of BTC (integrated OHS knowledge, decreased OHS risk, and decreased injury & illness). At the core of the model, there is the transformation of knowledge: before BTC, the knowledge is unknown and external to the organization; by the end, it is integrated within the organization. Five other elements were found to be important for the occurrence of BTC. Three are concerned with the process of change: responsiveness to OHS concerns, positive social dynamics and continuous

improvement pattern. Two are concerned with the internal context: simultaneous operational improvement and supportive internal context. The last of these was based on cross-case observations of senior management support, good management-employee relations, low turnover and a maintenance function responsive to OHS concerns. Discussion: Considering the results at a high level, we note that none of the BTC narratives had a “magic bullet” remedy for improving OHS performance. Instead, multiple organizational actions were involved, and most were concerned with the primary prevention of injury and illness. Interpretation of the study results was informed by reference to the literatures on organizational learning and positive organizational scholarship. Concepts with particular relevance from these literatures were absorptive capacity, boundary spanner and organizational energy. These may be useful concepts for use in future research. The largest limitation for this research is the lack of contrasting cases, i.e., those that continued to be among the worst 50% of firms in their respective sectors, instead of moving to the top 20%. These results are therefore regarded as a first step in an ongoing program of research.

# Improving risk assessment and prevention in micro and small enterprises, a major challenge for OSH stakeholders

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**Keywords:** SME; sectorial approach; online tool; risk assessment

## Abstract

In France, 98% of private companies employ fewer than 50 people. While small and medium-sized enterprises do not see risk prevention as a priority, statistics show without a doubt that the majority of occupational accidents occur in such small businesses in many sectors of activity. While prevention organisations in Europe face the challenge of reaching SMEs with regard to the implementation of prevention measures, there has been clamour at EU level to exempt small companies from certain OSH requirements. The introduction of a two-tier system offering EU workers different protection depending on the size of their company is not acceptable. The Directive 89/391/EEC requires companies to protect their workers' health and safety and to conduct a risk assessment. It is clear that SMEs need support to achieve those objectives. This is a challenge for all OSH organisations. They must demonstrate their capacity to develop adequate action plans tailored to the needs of SMEs. To address this challenge, the French national research and safety institute for the prevention of occupational accidents and diseases (INRS) is testing new approaches in specific sectors: construction, car repair, road transport and catering. Those priority sectors have been selected based on demographic and accident rate criteria. To develop those programmes and bring SMEs up to speed with occupational risk prevention requirements, a specific approach is needed for each sector : - marketing techniques are used to analyse target needs, - partnerships are built to reach out more closely to small companies, - Specific e-tools are developed to assist SMEs in complying with OSH requirements. In that regard, INRS has signed a partnership with the European Agency for Safety and Health at Work for the Online interactive Risk Assessment (OiRA) tool. OiRA is a European online platform to create free and easy-to-use sectoral risk assessment tools for small and micro-companies. INRS has developed OiRA tools to support risk assessment in target sectors. Those tools are also used to get statistical feedback on the implementation of the programmes. The aim of this presentation is to give an overview of this approach, share the content of such action plans and present initial feedback. In France, 98% of private companies employ fewer than 50 people. While small and medium-sized enterprises do not see risk prevention as a priority, statistics show without a doubt that the majority of occupational accidents occur in such small businesses in many sectors of activity. While prevention organisations in Europe face the challenge of reaching SMEs with regard to the implementation of prevention measures, there has been clamour at EU level to exempt small companies from certain OSH requirements. The introduction of a two-tier system offering EU workers different protection depending on the size of their company is not acceptable. The Directive 89/391/EEC requires companies to protect their workers' health and safety and to conduct a risk assessment. It is clear that SMEs need support to achieve those objectives. This is a challenge for all OSH organisations. They must demonstrate their capacity to develop adequate action plans tailored to the needs of SMEs. To address this challenge, the French national research and safety institute for the prevention of occupational accidents and diseases (INRS) is testing new approaches in specific sectors: construction, car repair, road transport and catering. Those priority sectors have been selected based on demographic and accident rate criteria. To develop those programmes and bring SMEs up to speed with occupational risk prevention requirements, a specific approach is needed for each sector : - marketing techniques are used to analyse target needs, - partnerships are built to reach out more closely to small companies, - Specific e-tools are developed to assist SMEs in complying with OSH requirements. In that regard, INRS has signed a partnership with the European Agency for Safety and Health at Work for the Online interactive Risk Assessment (OiRA) tool. OiRA is a European online platform to create free and easy-to-use sectoral risk assessment tools for small and micro-companies. INRS has developed OiRA tools to support risk assessment in target sectors. Those tools are also used to get statistical feedback on the implementation of the programmes. The aim of this presentation is to give an overview of this approach, share the content of such action plans and present initial feedback.

## Education and professional training into safety

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**Keywords:** education; safety; safety culture; implementation

### Abstract

In recent years, the concern with Safety and Health at Work matters had significantly increased either by the responsible authorities and workers. These alterations in mentalities are mainly due to a transition from a corrective culture to a preventive culture. Due to this change, it has been an increase interest from companies and institutions in applying this type of "culture" internally. This has been implemented by improving the workplace conditions and informing, raising awareness and training the staff regarding working procedures, and leads to an improvement in working conditions and a decreased in accident rates and occupational diseases. In fact, the last one is one of the main purposes of Safety and Health at Work: the promotion of employees' health and welfare and the control of occupational hazards, leading to a significant improvement in work conditions. The School of Health Sciences (ECS) has a leading role in Portugal regarding two distinct areas: research, through the Life and Health Sciences Institute (ICSV), and in education, through the School of Health Sciences (ECS). Since currently in Portugal there is no legislation concerning the Safety and Health at Work and, the School of Health Sciences (ECS) - Life and Health Sciences Institute (ICVS) at the University of Minho felt the need to create a team for the implementation of a safety culture in the Institution, since the safety and health of employees, researchers, teachers, students and visitors are a key concern for the Institution. In an attempt to fill this gap, the School of Health Sciences (ECS) has been developing several sessions of theoretical and practical training to its researchers, students and faculty staff. These sessions range from themes such as Safety and Health at Work training to Laboratory Risk. During the implementation of these sessions at ECS, we hypothesized that maybe it would be interesting to implement this "Safety Culture" at earlier formative ages. It is generally accepted that the yearly acquired habits are more easily maintained later in life. This is mainly due to the fact that the younger ages are more easily adaptable and moldable to the acquisition of new knowledge and content. Therefore, we hypothesized that the success of a "Safety Culture" would be more easily guaranteed if it was perceived as an acquired habit and not an imposed activity. This idea is the exact opposite of what currently happens in Portugal, in which, only the individuals with interest in this subject have access to proper information. Additionally, and by looking at the examples of some countries of northern Europe (where this practice is already implemented), it would make sense to implement a "Safety Culture" since early academic years (such as high school and university) in order to create a generally accepted practice concerning this subject. This raises other important questions such as "Does this make sense in a specific curricular plan?", "Will it bring more advantages to invest in the education for safety instead of correcting malpractices?", "Would it make sense to create educational platforms in order to motivate and appeal to the Safety culture?" Our Institution believes that this would be the most appropriate way for a more secure future. In this work we launch the challenge that, with proper Institutional support, the education for a safety culture should be implemented at a national level since early academic years.

## **Case study: analysis and verification of the requirements of security of the thirty-six regulatory standard in the fridge enterprise located in the midwest of Minas Gerais**

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**Keywords:** prevention of accidents; Life Quality; Secure

### **Abstract**

Nowadays, the security aspects are very important to enterprises, because the number of the labor accidents increased, bringing losses to the organizations and damaging the health and the life quality of the employees. The advantages acquired for the organizations that worry about this subject are motivation employees, to know that they work in a secure environment and to know that they have good situation to work with tranquility, increased of productivity and the improvement of the company image. Therefore, the regulatory standard has the objective of standardize and help the enterprises with the security procedures, with the objective of conserve the health and the life quality of the employees and protect them of possible accidents of work. The finality of this report is exhibit the secure measures that are used of the organization located in the Midwest of Minas Gerais that works only with slaughter and storage of pigs in the cold chamber. The fridge in question works with the slaughter of pigs, which occurs about two to three times a week according to the demand. The company conducts its activities from fertilization of pigs, maternity, nursery and fattening to slaughter process that is the focus of study of the work. It perform a search literature that covers all involved topics of this report. Furth more, are used, with analysis procedure the direct observation to identify all the risks that the work environment cause to their employees. The conformity of the enterprise with the thirty-six regulatory standard are checked and the nonconformity, are checked too. According to the articles of the thirty-six regulatory standard, there are twenty-nine conformities and seventy-two nonconformities, of the one hundred and one. The articles that are comply according to the thirty-six regulatory standard, are very important, like and in relation to platforms, walkways and platforms the company follows all the requirements thereof, thus offering greater security for workers to carry out the fridge activities. Already, the non-conformities, the enterprise does not practice most of the requirements of the thirty-six regulatory standard, like with machinery and temporal organization of work, which do not have any item that was conformity. The company has no program of environmental risk prevention and medical control of occupational health. Workers are not subject to the postural changes that help prevent musculoskeletal overload and reduce fatigue, and are not informed about the use of personal protective equipment and its limitations on what are the necessary procedures in emergency situations, the agents chemical, physical and biological they are exposed to, the biomechanical risks, risks from machinery and its components and precautions relating to communicable diseases. Thus, there are no technical and administrative controls exposure noise, periodic monitoring of exposure and control measures, training and information to workers, determination of personal protective equipment and no history of occupational diseases worker. It is possible realize that the enterprise has more non-conformities than conformities; it causes risks to the health and secure of the employees. The problem is that violation of the thirty-six regulatory standard increases the chances of the employees of that company to be victims of accidents and there is the possibility of the employees of they have diseases because of work and if it happen the enterprise is the only responsible of that. This enterprise should have a program to health at work to prevention of accidents.

# Smart prevention for sustainable safety

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**Keywords:** Safety of machinery; human-machine interactions; safe contact; Safety data

## Abstract

Title: Human-machine interactions: Mechanical safety data for physical contacts between moving machinery and people. Topic: Research into practice Author(s): Alberto Fonseca Mechanical Engineer; Technical manager of Equipment Safety and Engineering department of CATIM. Cláudia Pires Industrial Management Engineer; Quality Department of CATIM. Affiliates: ISO/TC 199 – Study Group 1 Key words: Safety of machinery; human-machine interactions; safe contact; Safety data. Abstract Current strategies to prevent injury due to the contact between machine, or their moving parts and a person are to keep them separated or by limiting the force of contact when it occurs in order to ensure that it happens in a safe way. Looking ahead more and more applications are being developed that require machines and people to positively interact, making the strategy of isolation increasingly difficult to apply. Designers, installers and integrators of machines must therefore turn to 'force minimization' for machine safety. But what exactly does this mean and can it be defined in a way that is generally applicable to all machines without creating unreasonable and impractical constraints? Is it possible to apply it in an 'uncontrolled' environment where ordinary people are exposed to machines? And how can it deal with robotic or autonomous systems which create the additional complexity of unpredictable or unexpected interactions? Considering this questions and having into account that existing data about this issue is scattered, focused in specific applications and cannot easily be transferred to different or more complex applications the International Technical Comity for Standardization ISO/TC 199 – Safety of machinery decided, last year, to create a Study Group – ISO/TC 199 SG01 Safety data for human-machine interactions – with a purpose of prepare an International Standard that would support the design, development and use of machines that will interact with people. The Study Group defined as main steps to started the work (within others) the identification of existing a data and solutions that have been developed elsewhere, classification of human-machine interactions (Speed, Energy, Size / Compliance of contact surface, Person or body constraints, Location of contact, etc), look for potential strategies and solutions, other than simply limiting the speed, force or energy that have been used elsewhere to prevent injury, and Look for other potential strategies and solutions based on human-human interactions or more generally on human behavior. In a crowded city people interact with each other all the time without causing injury. Can this human solution be used? Is the shape, flexibility, stability or instability of a human an important contribution to this? The Group has already proposed the approach to define Safe Contact and agreed that there are two dimensions to incorporate in a basic definition of a Safe Contact: - Level of risk. For that risk groups were defined that range from inherently safe machines that can cause no injury under any contact situation through to machines that have the potential to cause injury, to machines that that would cause injury. - Complexity of a machine. Machine complexity allows for the ability of the machine to detect and compensate for the contact. The simplest machines must be highly constrained, while more complex machines that can detect the nature of a contact can operate with much higher limits. This communication aims to make the point of the work that have being done by the Study Group, show and share the results of this work and, as far as possible, enlarge the net for sharing ideas, information and experiences in order to obtain the widest possible contribution to the ISO standard that is intended to be prepared.



## ‘Cold’ side of safety

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**Keywords:** New technologies; Cryogenics; Very low temperatures; Risk Prevention; Pressure Relief

### Abstract

Sub-Topic: "Lessons from the history of safety: measures, models, methods – where to next?" Over the past few decades, the breach in new technologies has emerged at a large scale. Technologies with new concepts, practices and procedures to which Health & Safety requirements shall be integrated from the very beginning. At CERN, we are faced with a variety of R&D programs, e.g. cryogenics, which develop new technologies that are not 100% applicable in the existing Safety standards available in the industry today. Cryogenics is the branch of physics that deals with the production and effects to material at very low temperatures ( $< -150^{\circ}\text{C}$ ). New technologies, like experimental cryostats or superconducting magnets, should continue to ensure its Safety during operation, even at a temperature that can go below  $-270^{\circ}\text{C}$  (as cold as outer space). Besides the accelerators, several other experiments use cryogenic apparatus (also known as cryostats) to study the properties of some particles, creating additional risks which are specific for these kind of installations. Two of the main occupational accidents, that are most likely to occur in cryogenic systems, are mentioned in this talk: Explosion (i.e. overpressure) and Asphyxiation. The risk of such occupational hazards increases with the increase of cryogenic applications exposed to workers over the past few decades, consequently trauma prevention measures and Safety requirements imperatively need to increase in the same order of magnitude. One must not forget that over the past decade, cryogenic applications didn't only increase in the industrial sector (e.g. MRIs, superconductivity, food industry, rocket science, etc.) but also in the R&D sector (including small academic labs). Why is it so important to look carefully into the cryogenic risk? Compared with the chemical or petroleum industry, a cryogenic accident can happen within a blink of an eye. The time between a failure and explosion may take a fraction of a second, eliminating many possible warning signals as compensatory measures. This talk will enter more into detail about this phenomena and why it's important to ensure that all precautions are made early in the design to avoid occupational accidents. Just as an indication, a small 500L cryogenic Dewar (typically used in labs) may, in case of an explosion, store the amount of energy of about 10 kg TNT equivalent (which can compare to an anti-tank mine). Safety standards and best practices do exist in the field of cryogenics but, as in most domains, they are generally inserted in a few 'envelope' cases commonly used in the industry. R&D of new equipment are deemed to fall (within a certain extent) out of these 'envelope' cases. How should one help engineers implement Safety during the conceptual phase for this new technology? How to certify them according to the Rules? The main objective in these cases is to find a harmonized approach, based on lessons learnt and theory, to assist the engineers/designers in developing new models and transfer the knowledge to the industry. The collaboration potential between research laboratories and the industry can perform major strides with respect to the implementation of Health & Safety requirements onto new technologies. A compromise between small amounts of lessons learnt, due to the fact that we are talking about "new" technologies, and theory may be the best approach in order to develop new methods and models for the mitigation of occupational accidents. This talk will also illustrate the method, adopted at CERN, on how to integrate Safety requirements to new technologies in the field of cryogenics and how to cope with eventual lack of tailored standards, guidelines or best practices in very specific fields. Such approach includes the collaboration with a university in Germany, Karlsruhe Institute of Technology, and the development of a novel software called Kryolize®, which is used not only at CERN but in many other similar research laboratories around the globe. Kryolize is a software used for sizing the minimum discharge area of a pressure relief Safety device, to protect cryogenic equipment from an accidental overpressure scenario. The software is adapted from International (ISO), European (EN) and American (API) standards and is based on approximations from the field of fluid dynamics which favours a variety of projects around the globe as well as the knowledge transfer between other institutes in subjects like 'supercritical cryogenic fluids in condensing two-phase flow'. The development of such software will disseminate the know-how and allow the standardization committees to update or create new standards.

# Latest findings and innovations in EU specific psychosocial risks regulation

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**Keywords:** Regulation; Psychosocial; Compensation; EU Law; Working conditions

## Abstract

This paper will show a probable psychosocial risk regulation picture by showing European latest regulatory approaches to these issues. We are actually facing a deregulation framework that must begin to face this new reality. Therefore to promote a regulation change to solve the actual lack on this problem should be an European priority. A strong effort is to be done by engaging psychosocial risks, national regulations and E.U legal framework, where uprising of mental disorders and psychosocial illness and diseases actually brings new challenges for workers occupational health, safety and wellbeing. Our actual legal range shouldn't stop in social security compensation, it should focus on a complete and holistic compensation of the harm suffered (including in personal aspects such as dignity, integrity, workers honour and non discrimination practices). This whole approach is nowadays necessary from EU policies, but it's also an issue to be faced by non-legislative instruments. In this paper we may see some regulation developments that some countries are trying by adapting their national regulation to their working conditions framework reality. Psychosocial regulation in Belgium: Recent changes defines psychosocial risks range from an innovative point of view, putting them on the same level as traditional risks; it defines the key actors role associated to this issue, and modifies the intern procedures related to intervention, complaint and refers to victims possibility to ask for a compensation when infringement occurs. The original regulation figures as follow: Act 28 February 2014 Wellbeing related to violence, sexual and moral harassment Act 28 March 2014 Order April 2014 related to psychosocial work related risk prevention. Even if it may seem surprising, this regulation puts end to the indetermination that have ruled in the latest national European regulations (EU framework exception, where this definition is more specific) in psychosocial risks/diseases definition. That's why this regulation considers a new definition of what it's understood as work psychosocial risks, not limiting the ambit of the definition to aspects associated with work-related violence such as mobbing or harassment. This innovative regulation becomes more familiar with Nordic countries legal treatment, by defining with accuracy the key actors and their role in the business structure. Sexual and moral harassment treatment also suffers several changes, according to justice reparation and compensation economic terms. These aspects widely develops European legal framework when talking about workers protection. Psychosocial regulation in Denmark: Working on this whole approach concept, this regulation will include prevention of violence against workers outside of working hours and workplaces, adapting their regulation to new forms of work (globalisation, new models of work and organisations) A law enacted on 1 February 2015 will oblige employers to prevent the risks of violence perpetrated by people outside the firm against their employees, outside of their working hours and workplaces. The functions performed by the employee, especially if, as part of his duties, the employee takes decisions that could have very significant consequences for customers, private individuals or users. Croatian Psychosocial legislation: A new law has introduced measures to protect people from stress at work in Croatia. The Law on Occupational Safety (OG 71/14) came into force on 19 June 2014. It has a similar structure to the previous Law on Safety at Work adopted in 1996, which had undergone seven amendments. This is the first time in Croatia that a law has introduced measures to protect workers from psychosocial risks (stress) and psychophysiological strain at work. The act introduces a general principle of risk prevention and protection of health at work. It brings in rules on the elimination of risk factors, procedures for the training of workers and procedures for providing information and consultation. Non governmental regulation example. United Kingdom Psychosocial non-legislative approach: The way we work is changing and in-demand skills such as teamwork, collaboration, joint problem solving, flexible, lone working and staff development all require employees who are mentally healthy, resilient, motivated and focused. Open and supportive workplaces benefit everyone; employees, employers and the bottom line. Mental Health Campaign and Business agreement: We're ready to talk. Rethinking the approach to mental wellbeing in the workplace. Time to Change is England's biggest programme to end the

stigma and discrimination faced by people with mental health problems. The programme is run by the charities Mind and Rethink Mental Illness, and funded by the Department of Health, Comic Relief and Big Lottery Fund. Over 200 organisations have made a public commitment to tackle mental health stigma. This innovative business agreement tries to overcome the regulation barriers in this issue. Yet there remains a culture of silence around mental health at work and businesses are reluctant to report publicly on the proactive steps that are being taken to foster mental wellbeing. Employers and employees are unwilling to talk about stress, anxiety and depression openly. Conclusions and future framework. The potential consequences of psychosocial burdens (pressure, isolation and loss of social support, new communication technologies, flexible working time, impossible deadlines, restructuring...) include cardiovascular diseases, musculoskeletal disorders, dermatologic problems, suicide, relationship problems with colleagues, family and social networks, and increased risk of violence, with consequences for both physical and mental health. In the medium term, companies suffer from absenteeism due to lengthy illnesses, and turn-over and productivity are damaged. It's not anymore an issue just related to harassment and violence at work as main EU regulation cover. EU latest drafts on occupational health and safety policy are still not tackling properly these contingencies. Social dialogue at different levels and professionals, EU regulation adaptation and business involvement is more than ever required. Further developments in this topic should continue, especially in countries where policies are still less developed.

# Safety as an emergent property of the production system: work practices of high-reliability construction supervisors

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**Keywords:** Production System Design; Work Practices; High Reliability Supervisors

## Abstract

Construction work involves many dynamic and hazardous processes that are adapted to project-specific requirements and context. These processes combined with high production pressures and workload create high potential for errors and accidents. Successful operational performance requires both high production and high safety performance. Thus, a significant challenge for construction researchers and practitioners is to develop production systems that are simultaneously highly productive and highly safe under the demanding, complex, and dynamic conditions of construction projects. Towards this aim, this study investigated the work practices of exceptional field supervisors who consistently achieve very high levels of both productivity and safety. The loosely-defined work processes allow the work crews many degrees of freedom in how they organize and manage the work. The design of the production system is typically performed by field supervisors operating within organizational, financial and project constraints. The field supervisors determine to a large extent the work division, sequencing, task allocation, workload and pace, coordination, performance controls, etc. Thus, a deeper understanding of the work practices of exceptional supervisors will contribute towards developing production systems that are more effective and safe under complex, demanding and dynamic conditions. The study was guided by the following research questions: What are the work practices and work design principles that support both high production and high reliability? How do the exceptional supervisors cope with the multiple demands for speed, efficiency, and safety? What are the mechanisms by which their practices mitigate the likelihood of accidents? The research used a case study approach. In-depth field studies documented the production, safety and crew management practices of exceptional supervisors in four high-risk construction trades: residential framing, masonry, concrete, and roofing. The practices of each exceptional supervisor were compared against the practices of an average performing supervisor from the same organization. To identify exceptional supervisors, participating contractors evaluated their supervisors based on their (1) safety incident rate and severity, and (2) production performance and project difficulty during the previous three years. Interviews with the operations and safety managers were conducted to understand the organizational context, including the safety management policies, hiring policies, supervisor and crew training, compensation and bonuses, work method selection, and supervisors' level of decision-making regarding the work process. Cognitive Task Analysis methods were used to understand the supervisors' goals, strategies, priorities, production difficulties, approaches to different situations and problems, reasons for their practices, etc. The researchers performed extensive field observations and interviews with many project participants (multiple interviews with the supervisors, workers, managers, safety professionals, etc.) to understand the production practices and their implications. About 20 site visits were conducted for each trade, including observations of average performing supervisors. The field data collected was organized under three categories: (1) production strategies, including supervisors priorities, production planning, production organization, work method selection, work sequencing, task assignments, setting production goals, production controls, etc.; (2) Safety management practices, including safety training, enforcement, safety activities, toolbox talks, etc.; and (3) Crew management strategies, including crew members selection, orientation, team planning, task assignment, training, etc. The findings indicate that the exceptional supervisors used a combination of strategies that aimed primarily at preventing errors and variability, while at the same time, increased the speed of production. Specifically: - The primary focus of exceptional supervisors was to prevent errors, rework and incomplete work. All their practices and strategies supported this “guiding principle.” - The exceptional supervisors were actively looking for production difficulties and risks on each project, while the average supervisors operated largely based on repetition (“do as before”). - They organized the process for speed by using smaller batch size and completing smaller batches of work—as a result, they had less work in process at any time. - The exceptional supervisors organized and simplified the activities to reduce complexity and physical demands on the workers. - They

prepared the activities thoroughly to avoid production surprises and interruptions. - They mitigated the production pressures on their crews to prevent rushing and errors. - Their crew management practices kept their crew informed and focused. The task assignments balanced the need for efficiency, with workers' learning and development. - They continuously monitored for errors, threats and difficulties, and responded fast to excessive workload and problems. - An unexpected finding was that there were significant differences across the cases with regards to the control of hazards. The safety measures taken to mitigate the workers' exposures to hazards varied from very limited to extensive. Despite this, the exceptional supervisors were able to avoid accidents even under conditions of significant exposures to hazards. The findings provide significant converging evidence that the production strategies that prevent errors and variability are essential in preventing accidents, as they generate "high quality work situations" for the workers. Such situations mitigate the task demands, enhance the workers' ability to adapt to high demands, and reduce the opportunities for errors and violations, even if the work process and hazards are the same. On the contrary, an ineffective production system generates low quality work situations. Safety efforts create further friction with production, and the safety outcomes are likely to be poor. This is not to say that strong efforts to control hazards are not important, but they are not sufficient to overcome the problems of an ineffective production system.

# Organizational resilience and quality of service: the mediating role of job satisfaction

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**Keywords:** Organizational resilience; Quality of service; Job satisfaction; High reliability organizations; Safety

## Abstract

The safety culture has been advocated as a better approach to safety management. In more recent years, organizational resilience has been introduced as an innovation in safety management, regarding the organization's capacity to continue operation and recover from unexpected situations. A key idea is that resilience is more than the ability to continue functioning when there is stress and disturbances. This strength can then be translated into competitive advantage during and after industry crises or negative trends. This study empirically explores the influence of organizational resilience in the quality of service perceived of workers in a high reliability organization, considering that the highest percentage of investigations in organizational resilience, have used the methodology of case studies and theoretical models, and empirical research is scarce.

The present study aims to advance the knowledge of organizational resilience, its conceptualization, measurement and its effects on quality of service. Specifically, the objective is to study the relationship between organizational resilience and quality of service perceived as well as evaluate the mediating role of job satisfaction in this relationship. We used a quantitative and cross-sectional design. To test the hypothesis, we adopted a causal design, based on the survey method, with self-administration of anonymous and confidential questionnaires. Our sample was composed of 326 participants from an organization of Spanish nuclear industrial sector. All responsibility levels and functional areas in the organizations were included. Our hypothesis predicts organizational resilience will positively predict quality of service (Hypothesis 1) and job satisfaction will mediate the relationship between organizational resilience and quality of service (Hypothesis 2). Organizational Resilience was measured with seven items designed and adapted from the theoretical approach of Weick and Sutcliffe (2007). Quality of Service and Job Satisfaction were assessed by items selected from the OCI (Organizational Culture Inventory, 1987). In the data analysis, initially were used descriptive and correlational methods. The next step was to test the factorial structure of the scales used, in order to obtain evidence of their validity. Finally, theoretical models were tested with Structural Equation Modeling (SEM). For evaluating model fit, we considered the use of a range of goodness-of-fit indices following the recommendations of literature (Kline, 2005; Byrne, 2009; Hair et al. 2010).

Results indicated that Job Satisfaction turned out to be a mediator between Organizational Resilience and Quality of Service, with a positive relationship. However, there was no support for direct influence between Organizational Resilience and Quality of Service. Then, we compare the fit of this partial mediation model with that of an alternative full mediation model. Results indicate that the fully mediated model is the best model to explain this relationship. This study contributes to the development of an integrative theoretical model on organizational resilience and on their consequent variables. These findings are discussed based on the scientific literature and have relevant practical implications suggesting that organizational policies that support the organizational resilience should be encouraged. Limitations and recommendations for future work to enhance these findings are presented in the poster.

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# Differences in the prediction of safety outcomes among immigrant and native workers

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**Keywords:** workplace accidents; burnout; well-being; personality; safety climate

## Abstract

We live in a globalized era where local events can come to have significant consequences in quite distant parts of the world. One of the consequences of Globalization is the substantial growth of migratory movements and its implications into the work setting, e.g. safety at work. Regarding this topic, there is a considerable amount of research showing that immigrants have more workplace accidents than natives. At the light of these results, the question is why immigrant workers are involved in more accidents than native workers. The main explanation is that immigrants have to perform more hazardous jobs than natives and have a precarious job. Implicitly, this explanation supposes that there are no differences between immigrants and natives. However, a considerable amount of research developed at the individual-level have shown that migrant people has a different profile than people who stay in their country of origin (a kind of “migrant personality”). Following this idea, the present study contributes to fill a gap in the literature, focusing on individual-level predictors of safety outcomes. Specifically, our objective is to analyze the differences in terms of personality and perception of safety climate between national and immigrant workers in the prediction of three different safety outcomes: workplace accidents, emotional exhaustion, and lack of well-being.

Three hundred and ten participants (43.58% immigrants, 57.42% natives) that work in Spain collaborated with the study. The predictive models were performed using logistic and multiple regression analyses, using ‘Big five’ personality traits and perception of safety climate as predictors, and workplace accidents, emotional exhaustion, and lack of well-being as criteria. All these variables plus the biographical data were assessed with a self-administrated questionnaire. Results show different predictive models for each collective: (1) regarding accidents, predictive models for immigrant and native workers has similar explained variance (12% for immigrants and 10% for natives) but with openness ( $B = .10$ ) and safety climate ( $B = -.06$ ) as predictors in immigrants, and agreeableness ( $B = .12$ ) in natives; regarding emotional exhaustion, the model developed for immigrant workers has an explained variance of 21% with emotional stability ( $\beta = -.39$ ) and agreeableness ( $\beta = -.18$ ) as predictors, whilst the model developed for native workers has an explained variance of 10% with emotional stability ( $\beta = -.32$ ) as predictor; (3) regarding lack of well-being, the model developed for immigrant workers has an explained variance of 20% with emotional stability ( $\beta = -.37$ ) and extraversion ( $\beta = -.20$ ) as predictors, whilst the model developed for native workers has an explained variance of 35% with emotional stability ( $\beta = -.36$ ), conscientiousness ( $\beta = -.24$ ), and extraversion ( $\beta = -.21$ ) as predictors.

As a whole, the results of this study are further evidence that is necessary more effort in the study of the relationship between immigration and work, and in the promotion of healthy work environments for all workers, irrespectively of their origin. Nevertheless, we recognize that the study has shortcomings: (1) the use of self report measures, that could produce common method variance; and (2) the use of a cross-sectional design instead a longitudinal one. These limitations are usual on industrial and organizational psychology research, especially in topics where there are no prior studies as this one. In any event, we propose that further research try to use different research methods and longitudinal designs to obtain better results. Regarding future research, we would like to stress that more studies about the relationship between immigration and workplace accidents are needed. There is evidence that immigrant workers have more accidents than native workers. Thus, our role as researchers is to investigate the personal and contextual factors that determine it, to guide practitioners in the promotion of safety work environments.

# Development of a new handling aid for disabled passengers aboard aircraft

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**Keywords:** Aircraft; Handling Aid; Handicapped; Flight Attendant; Musculoskeletal Workload

## Abstract

### Object:

The Regulation (EC) No 1107/2006 of the European Parliament, concerning the rights of disabled passengers and passengers with reduced mobility when travelling by air, released higher efforts for flight attendants.

The flight attendants are stressed by high physical workload during the support of disabled passengers aboard aircraft. Especially while moving them from a seat to an onboard wheelchair (or reverse), musculoskeletal overload must be assumed. Up to now there is a lack of operation strategies enabling safe and effective passenger handling with acceptable musculoskeletal workload. The present study explains the development of a handling aid to move disabled or to evacuate collapsed passengers with reduced musculoskeletal workload for flight attendants.

### Practice:

In a multidisciplinary team consists of experts in the fields of ergonomics, biomechanics, physiotherapy, health and safety and aviation we start to analyse the required tasks and resulting needs to support a disabled passengers aboard an aircraft while moving from the passenger seat to the lavatory. In the next development step we checked the ability of different moving aids especially from the rescue or healthcare branches and verify the fulfilment of special aircraft requirements like small size and lightweight. In the next step we designed a new handling aid and developed some handling strategies to use it aboard an aircraft to support disabled passengers in an adequate and respectfulness way. For the iterative design process we took a number of interdisciplinary workshops in a cabin mock-up of an Airbus A340-600 aircraft which was especially built-on at the Leibniz Research Centre for Working Environment and Human Factors at the Technical University of Dortmund. After the successful development of a new handling aid prototype we start a usability evaluation with 10 flight attendances in the cabin of a real aircraft in the Lufthansa Aviation Training Centre at Frankfurt am Main.

### Results:

We decide to prefer the technology of sliding sheets from the health care sector which was most suitable to fulfil the given requirements from the aircraft company and configured a new type of sliding sheet consist of a silicon laminated polyester cloth in the dimension of 0.45 to 1.60 meter. This new type of sliding sheet worked out as the best solution for supporting passenger's transfer in our workshops. The subsequent usability test verified a pretty good user acceptance of 81% (System Usability Scale) and shows a good efficiency and effectively by using the sliding sheet. Our new handling aid enables the flight attendance to move a disabled passenger approximately in two minutes from the passenger seat into the onboard wheelchair (or return) or in round about one minute to evacuate a collapsed passenger from the cabin floor to the aircraft galley. All handling tasks took place with clearly reduced musculoskeletal workload for the flight attendances.

### Prospects:

In the next step we'll develop instruction guidelines for the use of the new handling aid and provide it to German airline companies. Furthermore the reduction of the musculoskeletal workload will be analysed in detail in a following evaluation study from the Institution for Transport and Traffic from the German Social Accident Insurance (BG Traffic and Transport)



and the Leibniz Research Centre for Working Environment and Human Factors at the Technical University of Dortmund.

# Pollutants in cargo containers

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**Keywords:** Pollutants; Containers; Ventilation

## Abstract

The Poster gives an overview of the problems with toxic gases in cargo containers. Important aspects are how to handle containers safely or how to open containers and protect the employees from occupational hazards. One problem hereby is an adequate measurement of toxic gases and advices how to deal with containers which might contain toxic gases.

The container, which was invented fifty years ago in the USA, made the world smaller and increased the world trade dramatically. Today more than 600 million 20 Feet Containers are handled annually by ports over the world. Meanwhile every year nearly 18 million containers enter Europe from all over the world. International trade containers are often fumigated or treated with pesticides. It is although possible that volatile substances arise as a result of production processes. Up to 20 percent of the imported containers may have too high concentrations of dangerous gases or vapours. Sometimes the concentrations of these undesirable gases and vapours are that high that they can have acute and chronic health effects on humans. Anyone opening and working in a container with an excess concentration of gases or vapours runs the risk of falling seriously ill. Residual levels of fumigants, as well as naturally occurring off-gassing chemicals emanating from the goods, constitute safety risks, which may affect uniformed workers upon entering the container.

Many fumigants as well as pollutants or industrial chemicals are odourless or their odour can be masked by other odours. Therefore they can only be detected by special measurements. Nonetheless most of these containers are not subject to particular labelling requirements. Fumigated ISO Containers should normally be labelled. They need to be accordingly marked on the outside with a sticker which states: DANGER FUMIGATION. This also needs to be indicated in the transport documents.

Several European studies have reported high levels of residual chemical levels in sealed shipping containers. The Australian Customs and Border Protection Service found similar results when testing containers in Australia. These findings raise potential issues for worker health when shipping containers are unpacked. Symptoms such as headache, concentration and memory problems, dizziness and nausea, irritation of the skin and mucous membranes, neurological and neuropsychological impairment, and reactive airways dysfunction syndrome have been reported among patients after contact with fumigants.

There are surprisingly few peer-reviewed studies reporting from screening ocean freight containers for toxic substances. In one of these few, just >2000 incoming containers were investigated in the Port of Hamburg during a 10-week period in 2006. The most frequent contaminants found were formaldehyde and benzene and, among the fumigants, methyl bromide, phosphine, and chloropicrin. Among the non-peer-reviewed studies, roughly 300 randomly selected import containers were examined in 2002 in the Port of Rotterdam. Methyl bromide, formaldehyde, and phosphine were found in 21% of the containers. In 5% of the 300 containers, the levels of these fumigants exceeded the Dutch 8-h occupational exposure limits (OEL). In a study of 50 000 containers in the Benelux container terminals during 2010, volatile chemicals were identified and grouped according to the type of goods transported. The most common chemicals identified were 1,2-dichloroethane, carbon monoxide, formaldehyde, toluene, and benzene at a frequency of ~2% each. Phosphine was present in 0.08% and methyl bromide in 0.06% of the containers. Personal exposure to 13 selected residual chemicals is reported in a recent hazard surveillance published by the Safe Work Australia. Residual chemicals were detected in 74 of the 76 investigated containers. The most common volatiles were toluene, C2-alkylbenzenes, and methyl bromide..

It is recommended to use a systematic approach when handling containers. For example, containers can be divided up into various groups depending on their supplier, their country of origin and their contents. Each group will be assigned a certain course of action in order to minimize hazards. A container received from a new supplier or containing goods in wooden packaging could for example be allocated to a high risk group. Such containers will have to be

analysed with respect to pollutants before entering them. Maybe the containers have to be ventilated before employees can unload them. Another possibility is to unload the container under ventilation. We did some research recently to measure the effect of ventilation of loaded and unloaded cargo containers. As part of our attempts, which have not yet been published SF<sub>6</sub> was used as Taracergas to measure at different points in the container, the air exchange and to draw corresponding conclusions.

The results from this and an other studies illustrate the need to establish practices for the safe handling of ocean freight containers.

Containers transporting goods which are normally not fumigated and where experience has shown that they do not outgas industrial chemicals constitute a low risk. There is, however, no ideal way of dealing with containers. The handling of containers must be adapted to the respective conditions at the recipient.

In order to find a solution for the handling of containers contaminated with hazardous substances, it is ultimately necessary to find a European or, even better, a global approach to ensure safe loading in the exporting countries, safe transportation and safe unloading in the importing countries, guaranteeing the protection of workers inside as well as outside of Europe.

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# Breakfast on the working population

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**Keywords:** Breakfast; Work Health Promotion; Occupation; Worker; Employ

## Abstract

**Objective:** Describe the available scientific evidence on the intake of breakfast as a health habit and its effects on the working population.

**Methods:** Review of the literature published between July 2005 and July 2015 in PubMed bibliographic database. The keywords were "breakfast", "intervention", "promotion", "program", "work", "worksite", "job", "occupation", "employ". All those observational studies or systematic reviews performed in active population in any country and in English or Spanish were included. Previous work in July 2005, published in another language and those for which no full text was available were excluded. The following information of the included studies was extracted: year, country, reference population, sample size and design. Subsequently the relevant information of each of them was discussed (prevalence of working population having breakfast, effects of the work health promotion program's and benefits of the breakfast among others).

**Results:** Of the 68 items found using search terms in the selected bibliographic database, 33 were excluded after reading the title and not meet the criteria for inclusion. After reading the titles and abstracts of the 35 relevant studies obtained, excluding those that were not directed at active population ( $n = 4$ ) and those whose content was not of interest ( $n = 13$ ). Of the 18 articles they were excluded those who could not provide the full text ( $n = 9$ ). Finally it became available 9 full text scientific articles. After reading the articles, it is observed that, although the active population recognizes the breakfast as an important meal, they often (some authors indicate that up to 50%) do not perform it. Possible causes were expressed in different articles: the limited time available during the morning, irregular schedules or working more than 65 hours per week. It has also been observed that smokers and singles eat breakfast most irregularly.

There are intervention studies, concerning breakfast, that demonstrate the effectiveness of programs promoting health in the working population (56.3% of hospital workers had breakfast before the program, while the percentage increased to 72.9% after the program). It has been observed that these programs produce positive changes in the lifestyle of workers. Also, employees who maintain and improve their lifestyle, including breakfast, have fewer cardiovascular risk factors and 10% 10-year risk. But no relationship was found with an improvement in Breslow's lifestyle index.

Some studies show that skipping breakfast is associated with significantly worse glycemic control (increase of 10.8% of the original value of HbA1C), which carries an increased risk of type 2 diabetes, diabetes complications, increased calorie intake in the dinner and increased body mass index (BMI). It has been shown that, of the five reference daily intakes (RDI), dinner is considered the most frequent, abundant and heavy meal of the day, especially in men.

In terms of job security, studies conclude that daily breakfast is associated with a lower risk of having an accident, suffered minor injuries, cognitive deficits and job stress.

**Conclusions:** The present work is the first systematic review of the literature which allows to observe the existing scientific evidence on the breakfast as part of the health promotion and a healthy lifestyle in the working population. Based on the review, we would expect that the implementation of the breakfast workers and campaign for health promotion in businesses would improve lifestyle, reduce episodes of temporary disability resulting from occupational accident or common illness (secondary to cardiovascular disease) and would reduce work stress.

Participants in the reviewed studies recognize that breakfast is a healthy habit but refer not carry it out by not having enough time in the morning. Although they are able to distinguish between healthy and unhealthy breakfast, who deviates the healthy option is driven by convenience and taste.

This review presents a number of limitations that must be taken into account. First, the search for scientific evidence has been performed on a single bibliographic database. Secondly, there are limited studies on effective interventions to evaluate the effects of including breakfast in the

working population. Third, the reviewed articles did not describe the content of the breakfast, without differentiating whether or not it is healthy, except in one study. Finally we could think that the generalization of the results would be limiting, diminishing the external validity, since most of the items (except 2 made in UK) have been conducted in Japan and USA.

The review of literature and the reading of the articles was made with the support of a second researcher, increasing the level of internal validity.

In conclusion, it would be interesting to conduct more detailed studies in order to assess the beneficial effects of including breakfast as a healthy lifestyle, describing the nutrients must have a breakfast to be considered healthy. Programs of work health promotion have proven effective because they produce positive changes in workers. Programs should include management strategies for time and factors around breakfast to improve compliance.

# Adaptation in unexpected safety-critical situations - a concept for resilient (simulator) team training for operating teams in a nuclear power plant

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## Abstract

1. Adapting to unexpected safety-critical situations – managing uncertainty in a resilient way

Industries with high risk-potential like nuclear power plants need to manage potentially critical situations on team-level for assuring reliable and safe operating. Safety is looked on as a "dynamic non-event" (Weick & Sutcliffe, 2001). Therefore, it has to be continually built on by the operating team through adaptive actions in relation to the situational context. Apart from the strategy to handle unexpected, unplanned situations by highly standardized procedures, teams in complex socio-technical systems have to be capable to switch to flexible team coordination in order to manage situations that are not covered by standardized procedures. The management of uncertainty by standardization and pre-planned procedures has to be accomplished by a resilient strategy of flexible problem-solving. On the operational level, this means, that the operating team needs knowledge, skills and organizational support (like tools and formal structures for flexible decision making on team level) for adaptive, resilient acting as a team to cope with unexpected and unplanned situations.

2. Adaptive competences of the operating team

What competences are needed by the operating team for adapting to unexpected situations? The notion of "resilient team processes" is yet not well established. One aim within the development process of the team training was therefore the discovery and description of relevant characteristics of team processes in the light of resilience. The field project in cooperation with a Swiss nuclear power plant wanted to contribute to the detection and formulation of specific team processes within the operating team that serve for safety oriented coping in abnormal situations for which no pre-defined action planning exists (resilient team-processes). In the middle of the analysis of resilient team processes the focus should lie on team activities for recognizing and adapting to variations, changes and surprises by adequate problem-solving and decision-making. Especially the development of modified situation awareness within the team seems to be important for effective adaptive problem-solving and decision-making. The situation assessment is the basis for further problem-solving activities and should involve intensive phases of information exchange and reflection within the operating team with possibilities for "speaking-up" (esp. reactor operators) and updating (esp. supervisor). The definition and training of competences within the team to fulfill these adaptive processes were the basis of the development of the training concept. Team members should be capable to fulfill the following tasks: Information collection / exchange (giving information, asking for information), explicit coordination of information exchange and attentional states (addressing by name, pointing), coordination of updating (speaking up, reflection, integration of all team members) for knowledge integration (Waller, Gupta & Gianbatista, 2004). The competences necessary for the situational integration of information, knowledge and experience of the team members for building common situation awareness and action planning represent the basis of the training concept.

### 3. Concept and methods for training adaptive team competences

The aim of this project was the development and evaluation of a concept for resilience-based team training by imparting knowledge and skills with regard to adaptive, resilient team behavior. The team training concept was elaborated and tested in collaboration with the instructors of the simulator training center of a Swiss nuclear power plant over a period of three years. The development process was highly participative and each step was discussed.

The starting point of the development process lies in the assumption made by authors of the resilience engineering direction (i. e. Hollnagel, Woods & Levenson, 2006), that teams are already capable of solving the challenges of their working field. It is one central assumption from the resilience engineering direction, that we can yet find relevant adaptive behavior in real, actual work practices on the level of individuals and teams within the organization. The approach of the project was, to elicit these successful team behaviors and strategies and make them explicit for the other operating teams and to build a tool out of these already existing adaptive competences for implementation on the organizational level (Brünger et al., 2014) as an organizational learning process (Kleindienst, Koch, Ritz & Brünger, in prep.). The methods used for training are capable to foster dialogue, reflection and shared practice within the operating teams. Especially the use of video-tapes showing sequences of successful adaptive behavior of real operating teams is useful for a kind of model-based learning. Team members can become more aware of the relevant features of successful practices (information exchange, coordination, strategies for updating, etc.). The videos show selected sections from simulator training scenarios referring to successful adaptive behavior of the acting operating team. The reference to entire sequences of team interaction in task context gives the (observing) team the possibility for discussion and reflection of successful practices. Out of this, they can further form a common basis about their conception what means "good" team interaction for adaptation in unexpected situations in the context of their own team (cultural learning).

The spreading and transformation of already available work practices to new knowledge was done within three phases, each emphasizing different aspects of the learning and acquisition process: (1) Information based phase, where information about adaptive behavior is taught, (2) the demonstration based phase, with the video-sessions and (3) the practice based phase, when teams used their new knowledge in a simulator scenario for having the chance to explore new behaviors and develop skills in this way.

### 4. Outlook

The evaluation of the training concept showed a positive attitude of the operating teams and acceptance of the usefulness of the adaptive behaviors for coping with unexpected situations. The training concept will be used further for simulator training of operating teams in the nuclear power plant. Special needs of different functional groups within the operating team (supervisor / reactor operator) will be analyzed and complementary training sections are planned.

# Projective guidelines for the construction of sorting centers with emphasis on its occupational health and safety aspects: case study in Recife - Brazil

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**Keywords:** Recycling; Solid Waste; occupational health and safety

## Abstract

In the current century, the management of issues concerning urban solid residues is a challenge. The Brazilian National Solid Waste Policy instituted in the year 2010, was a milestone in the Brazilian social, economic and environmental policy. The city of Recife produces the equivalent of 66,000 tons of garbage monthly. Of this total, between 25% and 35% could be recycled, but according to government statistics this number does not reach 10%. Contributing to a sustainable development, the waste collectors have a great importance in the current Brazilian society. However, the industries that purchase recyclable materials, acquire through intermediaries, which have the most profit through the resale process. It is assumed that the low volume of direct sales from waste collectors to industries, lies in the fact of the recent creation of recycling cooperatives, lacking of political, social and productive organization, and also many fail to fit the imposed requirements by the buyers, such as legal registration and own means of transportation.

The overall objective is to propose simplified guidelines for the construction of sorting centers, focusing on occupational health and safety to reduce the hazards by recyclables collectors' cooperatives, raising the awareness of society regarding the importance and dignity of this workers. In this paper, it was observed and described the work process, perception of occupational hazards for workers; and studied the particularities of sorting centers, the existing standards of physical infrastructure and safety that can be implemented in construction.

To understand the activities performed by collectors and necessary equipment for the operation of the sorting centers, interviews were conducted with the director of two recycling companies in Recife/Brazil and a member of the cooperative.

Along with these interviews, two intermediate companies located in the southern city of Recife were visited, in which were observed the following conditions: dirty floors, leaking pipes, structural gaps in the sealing of the workplace and storage, and the possibility of contamination of the collected material, given that the deposits of bales were exposed.

In the cooperative it was analyzed the collectors' routine and working conditions. They work from Monday to Saturday, eight hours a day. There were 20 women and 8 men, aged from 18 to 70 years old, only 3 to 8 have the 1st degree range and none of the collectors are linked to social security for retirement purposes and other labor rights. The material that reaches the cooperative passes through a selection according to their composition. About 30% of the material is rejected and is sent to landfill site. The workers wear uniforms and gloves. Lunch is made within the cooperative in a proper area. The following risk factors were observed: shed for material discharge with inappropriate lighting, small space for the collected material, risk of cuts and perforations caused by sharp materials in wastes, ergonomic strain on the body as result of manual lifting, heavy physical work, inadequate posture, repeatability, standing up or squatting work, trunk twisting and spine bending.

By the observed aspects, it is required the standardization of projective guidelines, for both work and living areas for workers. Thus, the projective guidelines proposed include the Brazilian national technical standards and international recommendations for Electrical Installations, Sanitary Conditions and Comfort in the Workplace, ensuring a comfortable place for meals; minimum areas for sanitary facilities; changing rooms with double closets; places to keep personal protective equipment; lighting, ventilation; parameterized exhaust and minimum height for pier height according to the living area.



Records of work safety training show the importance that organizations attribute to the prevention of accidents and occupational diseases. Behavioral changes will happen by campaigns and training to change the culture of workers in their daily activities. Therefore, it is critical that the society, educational institutions and government agencies support the educational activities for use of collective and personal protective equipment in cooperatives to avoid the injuries due to sharp objects, toxic products, glass powders, sawdust and aluminum, paints, solvents, with synanthropic animals (cockroaches, rats, scorpions) and other physical, chemical and biological agents.

Based on the field observation, current regulations and considering the 22 tons of waste per day produced in Recife/Brazil, the following general guidelines for a sorting center have been proposed: Edification project for the receiving activities, sorting and storage of the collected waste;

Layout with processing route of various materials, including the separation of materials by sectors, including including four sub-sectors for paper materials: white paper, corrugated, magazines, catalogs and newspapers, and graphic paper; calculation and convenient location for mechanical scales, capable of weighing up to 1 tone, mats for selecting, the press, baler for up to 4 to 6 bales of 300 kg per hour and for the forklift; It is suggested the use of simple galvanized sealing trapezoidal with thermic and acoustic isolation, with EPS filling, for example, between the two tiles to cover, considering its capacity to slow down flames and does not absorb water. Or the use of a green roof that provides the indoor thermal and acoustic comfort; To conserve and protect natural resources is suggested the capture of rainwater for cleaning floors and toilets, and to irrigate gardens; For the sewage treatment is suggested channeling to a continuous biodigester type; As a tool for social inclusion, its suggested the creation of a cultural and educational open space to the public for tours. The space can carry a store, classrooms, workshops for manufactured goods using recycled materials.

The idea of structured recycling centers permeates the concepts of citizenship, living in groups, dignified work, physical structure, hygiene, organization, preservation of health and protection from occupational diseases in the recycling area. From this perspective, the guidelines proposed contribute positively to the sustainable aspect, not just in the sanitation structure and adequate work conditions, as well as the recovery of citizenship by associations and collectors cooperatives, and the surrounding communities.

# Integration of the occupational health and safety management into the production management: a case study in the Brazilian steelwork industry

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**Keywords:** Integrated management systems; Health and Safety Management; Steel industry

## Abstract

The integration of the occupational health and safety (OHS) management into the production management is one of the main characteristic of an organization which presents a highly mature safety culture. There are many research papers published on this subject but the majority of them is focused on formal aspects of the management systems. Few of them present details on how this integration occurs. The general objective of the present study was to analyze the main approaches and practices adopted by a steelwork multinational corporation and to determine to what extent health and safety management is integrated with the productive process management. In order to do this, a case study was conducted involving two units of this corporation located in southeastern Brazil: a steel plant (unit A) and a wire drawing plant (unit B). The corporation has full ownership of the unit A. The unit B is a joint venture but it has the shareholding control. They were intentionally selected due to practical reasons: easy access and permission to carry out the study. The aspects considered in this case study were: safety policy; management commitment; planning, implementation and performance evaluation processes; leadership involvement in risk management; worker participation; competence and training; communication; risk management in the production line and maintenance activities; management of changes and contractors. It was also considered the three management levels: strategic, tactical and operational. The procedures of data gathering included: document analysis, interviews and observations carried out during visits to the processing plants. Data were analyzed and presented in a qualitative approach for all aspects. The integration level for each aspect was classified as low, partial or complete. The wire drawing plant (unit B) shows complete integration between OHS management and production management for all aspects and management levels. This represents a highly mature safety culture. The steel plant (unit A) shows a partial integration for the majority of aspects, except for OHS policy, worker participation and management of changes. The steel plant can still improve many points, such as incoherencies between discourse and practice, definition of roles, responsibilities and rules not always totally clear. The leadership members don't always take the safety questions as their responsibility. They don't recognize the overlap of production on safety issues, fail when accept risk conditions as part of the daily work conditions, fail when do not treat safety as a value. Some leaders don't have enough knowledge regarding risk assessment. There are failures in the communication process between the leadership and the shop floor workers. The control of occupational risks in the line production activities were well integrated to the others management processes. The main shortcomings were related to risk control in maintenance activities and to the contractors' management. Although of these two units are under the same corporation control, owning a OHS management system and the same corporate OHS policy and guidelines, they don't show the same level of management system integration. OHS performance and the integration level are lower in unit A. This could be explained because unit B is a joint venture and receives a cultural influence from the other corporation. The results of this study would be useful to improve the occupational health and safety management in Unit A. The approaches and practices of unit B would be a benchmark.

# Guidelines proposals for environmental indicators and for occupational and health safety in public and private organizations

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**Keywords:** Indicators; Sustainable Development; Security and occupational health

## Abstract

Over the years, organizations have tried to validate their commitment to environmental preservation, quality, safety and health at workplaces. These actions are intended to present a good corporate image, engaging employees, customers, shareholders, all in accordance to the regulations, thus developing an organizational culture dedicated to the social and environmental issues demanded by society, valuing their products and services. Furthermore, enhanced by the global economic crisis, it is observed an increase in temporary works, an aging workforce and migratory fluxes, favoring the acceptance of unsafe conditions, no health monitoring, the lack of verification of environmental working conditions, absence of proper records and reports of occupational diseases.

Therefore, what elements of these systems in the so-called “sustainable companies” consider the Health and Safety of their Employers (HSE) in the workplace? And which management tools could help these public and private companies to evaluate and monitor the HSE as an intrinsic element of sustainability?

For Elkington (2015), social and economic dimensions need to be more integrated to the environmental issues. The social aspect is concerned with the present and future generations, as the labor that supports development. In this scenery, progress versus sustainability, government, business and society have the same directive, demanding from each other involvement and commitment, urging a long term planning, under the risk of compromising the upcoming generations. There is no consensus of the meaning of “sustainability” and the operationalization of strategic plans to face this reality. Thus, one method to get a broader understanding of Sustainable Development (SD) is the establishment of operational tools to measure, evaluate, monitor and indicate the development progress versus sustainability.

Before World War II, the indicators were basically used by economic scientists and had a more quantitative approach. By its end, production was spread going to incorporate departments, agencies and government offices. Indicators can be defined as quantified information of a scientific nature, easily understood and used in decision-making processes at all levels of society, useful as verification tools of certain phenomena, showing its trends and developments over time. They are generally used to simplify and communicate complex information that can be used to access, diagnose, monitor and compare for example the different aspects of sustainability. This paper proposes to analyze quantitative and qualitative indicators of work security, which can be incorporated into the evaluation of the social aspect of the SD.

Currently, there are some indicators that measure aspects of sustainability in private and public organizations, with Global Reporting Initiative – GRI, and the Genuine Progress Indicator - GPI, which demonstrate the questions of civil society beyond the Policy Performance Index - PPI used to check the performance of governments. After analysis, the GRI indicators was chosen for its applicability in organizations of different sectors and sizes, corporate, public with ou without profits, and being present in more than two thousand companies in Africa, Asia, Europe, America and Oceania.

The GRI has international recognition and is adopted by large companies worldwide. Currently, the GRI Foundation published its fourth version - G4. GRI indicators are based on three aspects of SD and are useful for organizations that pretend to be accountable to society, the government, its customers and suppliers concerning to their good sustainability practices. The

GRI's goal is to establish a reporting standard with the same clarity, quality and consistency across all countries and institutions that follow their directives.

The GRI Report provides a guide for mapping and preparation of indicators. The environmental dimension covers the organization's impacts on natural systems including ecosystems, land, air and water; for these indicators will be evaluated if the organization's practices are in compliance with laws and efforts for the preservation, recovery and conservation of the environment. For social aspects, are considered the organization's impacts related to labor practices, the relationship between workers and management, health and safety, training and retraining, including subcontractors.

In the implementation phase, each organization is free to choose the criteria that they believe is important for the definition of indicators of environmental and social development, focusing on what and where it matters. On the GRI Standard, the indicators are composed of acronyms, where G4 means the version used, and other letters indicate the category of the indicator. To show to society its social and environmental responsibility, a company could choose the following criteria for measuring and monitoring in the Environment category - EN (Environmental): percentage of materials used that are recycled, energy consumption reduction, percentage and volume of recycled water and reused, total water withdrawal by source and total environmental expenditures by type.

For indicators of social class - LA (Labor Practices and Decent Work), it is suggested the choice of the following criteria: total number and rate of new jobs, hires and turnover by age group; gender, type of injury and injury rates; occupational diseases, lost days, absenteeism and work-related fatalities by region and gender; workers with high incidence or high risk of diseases related to the occupation; average hours of training per year per employee by gender and employee category; programs for skills management and lifelong learning that support the continued employability of employees and to manage career endings, and the proportion of basic salary, and remuneration of women to men, by employee category.

The creation of indicators of environmental and social management aims to guide any public or private company, with or without profits, in order to identify working conditions, training, collective and individual security devices, greeting legal obligations and other aspects relating to the social and environmental aspects of the SD in organizations. The proposal for the institutions that adopt these indicators is that investments made in the aspects of the SD allow comparisons between companies, and that these can be verify the application of resources are distributed in a way that represents in practice that their greatest asset are the people's lives that compose it.

# Occupational health and safety management in road construction in Brazil: a multiple case-study with focus on earthmoving activities

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**Keywords:** Road construction; Earth moving; Occupational Safety and Health Management

## Abstract

Being one of the economic sectors that employs great numbers of workers in the country, the construction industry also presents high levels of workplace accidents. In order to prevent these accidents and work-related diseases, all companies in this sector are required to comply with the Regulatory Norm number 18 (NR 18) – Working conditions in the construction industry, issued by the Brazilian Ministry of Labor and Employment. However, this rule was created having as a reference the building activity. This makes it difficult to apply it to road construction activities, which have their own characteristics, such as being held far from urban centers, having mobile workplaces and fractionated work teams, among others. The aim of this study was to understand the safety and health management practices adopted by companies operating in road construction, and to suggest improvements to this process. It concentrated only on earth-moving activities, but it considered all types of risk related to them. The research method was “multiple case study” involving three companies that operate in the Midwest region of Brazil. They were intentionally selected due to practical reasons: easy access and permission to carry out the study. Three aspects were considered: the company safety and health management framework, its legal compliance and risks during earthmoving activities. Data gathering included document analysis, field observations and interviews with workers and managers. Based on models of systematic management of safety and health at work, the study analyzed the effectiveness of the company organizational structure and risk management processes. The risk assessment was performed for the earthmoving activities, including risk identification, risk analysis and risk classification. The risks were identified and described by reference to potential events and negative consequences. The risk analysis process included identification of all risk factors and existing preventive measures and risk estimation. The risk levels were determined through a risk matrix that combines the severity and likelihood of the consequences. Severity and likelihood were rated using a 1-4 scale (1=low, 4=high). For prevention purposes the risks were classified as low, moderate, high and critical. Results showed that all three companies had an organizational structure for occupational safety management, which present different levels of maturity. The main difference between the companies was the way they fulfill legal requirements. While one of them is organized to ensure legal and regulatory compliance, the other two, for various reasons, cannot even meet these requirements. None of them has a voluntary management system such as OHSAS 18001. They only implemented the occupational safety and health programs required by law in such a way that in practice their contribution to promote prevention of accidents and the protection of workers' health is very little. The most vulnerable aspect was the monitoring of workers' health. Despite having different organizational structures for occupational safety and health management and different levels of legal and regulatory compliance the occupational risk levels proved to be the same in all three companies. The high risks were severe or fatal injuries caused by falling from different heights or by machine overturning as well as hearing loss due to noise exposure. The moderate risks included fatigue due to strenuous efforts and long working hours, cancer due to exposure to a particular substance containing polynuclear aromatic hydrocarbons (PAH), respiratory disorders related to dust exposure, and mental suffering due to psychosocial factors such as living away from the family. Improvements in the OSH management process were suggested as result of this study. Its conclusion is that the companies are only concerned about complying with legal requirements in order to avoid problems with the regulatory agencies. Very little is effectively done to promote workers' safety, health and welfare. Due to the NR 18 shortcomings and the way labor inspection checks compliance by focusing only in aspects related to comfort and workers' welfare, the fact of being in compliance with the law did not mean low or moderate risk. The results of this study could be

useful for reviewing the existing regulation. This review would be important to analyze the specific characteristics of the road construction activity, which is often held in remote areas and in unfavorable environmental conditions.

# Design and assessment of effective signs for railroad-crossings

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**Keywords:** railroad-crossing sign; risk taking process; positive reminder

## Abstract

### Purpose

The effective design for railroad-crossing signs was investigated using a questionnaire. Four different designs were developed. Two designs showed messages that prohibited certain behaviors in front of crossings, one design showed a message that appreciated drivers for their safe behaviors, and the last design showed a message that drivers were being monitored. Moreover, we assessed the degree of risk and developed a questionnaire based on risk taking process theory to examine whether participants take or avoid risks. The present study utilized this questionnaire and examined the effective design of a railroad-crossing sign.

### Method

**Participants:** Men (N = 41, mean age 30.5 years, age range, 23-34 years) with normal physical and psychological health participated in the study for monetary compensation.

**Signs:** Two signs prohibiting dangerous behaviors in front of the crossings ("The train is right here," and "Take your foot off the gas pedal"), one sign that appreciated drivers for their safe behavior ("Thank you for being safe"), and one design showing an image of drivers being monitored ("Be aware of the train warning") were developed.

**Questionnaire:** The questionnaire was developed according to Noro, Niimori, and Hara (2004). Each questionnaire item comprised one of three factors, with three items in the risk perception factor (the notion that the crossings are dangerous; "Do you think that there is a possibility of a collision accident with a train?"), three items in the implementation intention factor (intentions about safe behavior in front of crossings; "Do you stop at the railroad crossing signs?"), and three items in the safety attitude factor (safe attitude at the crossings; "Do you think you want to avoid collisions with trains and drive safely to protect yourself?"). Participants responded to the questionnaire using a 5-point scale ranging from 1 (completely disagree) to 5 (completely agree). Moreover, participants indicated their intuitive feelings when they saw the signs.

### Results

A two-way within factor ANOVA was conducted with mean score of each factor in the questionnaire as the dependent variable, and the signs ("Train is right here", "Release your gas pedal", "Thank you for being safe", and "Be aware of the train warning") and factors in the questionnaire (risk perception, implementation intention, and safety attitude) as the independent variables. The results indicated significant interactions between signs and the factors.

The results of multiple comparisons of the interactions indicated that the risk perception score for the sign "Train is right here" was significantly higher than for the other three signs. On the other hand, "Thank you for being safe" sign scored significantly lower for risk perception than "Train is right here" and "Be aware of the train warning" signs. Scores for the implementation intention were significantly higher for the "Train is right here" and "Thank you for being safe" signs than for the "Take your foot off the gas pedal" sign.

### Discussion

Results indicated that the "Train is right here" sign resulted in the highest risk perception score, whereas the "Thank you for being safe" sign scored the lowest. On the other hand, "Thank you for being safe" and "Train is right here" signs indicated the highest scores for the implementation intention, and the picture in the "Take your foot off the gas pedal" sign scored the lowest for implementation intention.

General risk taking process theory suggests that a person assesses the risk at unprotected railroad crossings, and that estimated risk leads a person to stop, or slow down, in front of the crossings. In this process, the "Train is right here" sign triggered the highest degree of risk perception among the four signs, and thus its score for implementation intention was also

relatively high. On the other hand, the risk perception score of "Thank you for being safe" sign was the lowest; nonetheless, its score for implementation intention was high, which is difficult to describe based on risk avoidance behaviors. It is possible that participants did not assess the danger when seeing the sign "Thank you for being safe" sign, however, they made a decision to stop, or slow down at this sign. The results for "Thank you for being safe," sign was consistent with a previous study that indicated that "positive reminders prompt desirable behaviors more than negative reminders"(Durdan, Reeder and Hecht, 1985). The present study indicated the possible usefulness of the study by Durdan, Reeder and Hecht in developing safe behaviors.



# Mitigating overstress on safety supervision of chinese special equipment, from symptomatic to fundamental

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**Keywords:** special equipment; safety supervision; work safety; systems thinking; shifting the burden

## Abstract

In China, Special equipment which include boilers, pressure vessels, pressure pipelines, lifts, cranes and hoists, passenger ropeways, large amusement devices and automobiles at worksite are administrated and supervised by General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ). Work safety (WS) related to special equipment are both regulated by State Administration of Work Safety (SAWS) and AQSIQ. Receiving its mandate from the State Council, SAWS is responsible for overall supervision, administration, direction and coordination of WS across the country. It also sees to the supervision and inspection of WS administration by other relevant national authorities such as AQSIQ and local (provincial, municipal and district/county) governments. In recent years, in order to improve safety at work, SAWS has strengthened its capacity for WS inspection and drafting of work rules and procedures. At the same time, under the condition with less increase of inspectorate, the rapid increase in numbers and types of special equipment has brought AQSIQ increasing stress on special equipment supervision. A lot of effort have been conducted to improve the effectiveness of safety supervision, such as drafting more serious rules and procedures, implementing risk assessment and improving administrative sanctions, but no evidence has verified the effectiveness of these solutions, nor has any research measured their performance. The aims of this research was to adopt proper method to analyze and evaluate the present solutions on the overstress on safety supervision in the WS inspection system of special equipment and then to seek its fundamental solution. Systems may consist of nonlinear, counterintuitive and dynamic feedback loops, and systems thinking is a discipline for seeing wholes. The approach of systems thinking is fundamentally different from that of traditional forms of analysis. Instead of focusing on separating the individual pieces of what is being studied, systems thinking focuses on how each component interacts with the other components of the system. It works by expanding its view to take into account larger and larger numbers of interactions as an issue being studied and has developed archetypes to map the nature of the system dynamically over time. The archetype of "shifting the burden" can identify both the symptomatic solution and fundamental solution of a problem, while it states that a problem's symptom can be resolved either by using a symptomatic solution or applying a fundamental solution. The approach of systems thinking was adopted in this research to analyze the present solution of "over-stress on WS inspection" from a dynamic viewpoint and applied the archetype of "shifting the burden" to provide its fundamental solution. The components of WS inspection system were identified based on Law on Work Safety and Special Equipment Safety Production Law, and the causal loop diagram was developed according to their responsibility distribution. It shows that the present solution is a "quick fixes" that appeared to be keeping the problem under control. Once the problem symptoms disappear, the incentive to fix the underlying problem likewise disappears, but new problems such as regulatory burden, cumbersome and bureaucratic sanctions procedure emerge. Further analysis also shows that the present solution has transferred the employer's (employing unit in China) responsibility to government organization and inspectors. Therefore, the fundamental solution should make the employer fully responsible

for all aspects of prevention in his/her undertaking. The philosophy of “self-regulation mechanism” based on Robens Report should be introduced and stressed in the system of work safety inspection.

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